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Apr. 15, 1950

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NUCLEAR SCIENCE ABSTRACTS

Vol. 4 No. 7

Table of Contents for April 15, 1950

Category	Abstract	Page
DOCUMENTS REFERENCE LIST		ii
BIOLOGY AND MEDICINE		295
Radiation Effects	1838	
Radiation Hazards and Protection	1851	
Radiation Sickness	1859	
Radiotherapy	1860	
Toxicology Studies	1906	
Tracer Applications	1939	
CHEMISTRY		315
Analytical Procedures	1953	
Fluorine and Fluorocarbons	1954	
Laboratories and Equipment	1956	
Separation Procedures	1957	
Synthesis	1958	
Tracer Applications	1959	
Uranium and Uranium Compounds	1962	
ENGINEERING		316
Pumps	1964	
Tracer Applications	1965	
Vacuum Systems	1966	
MINERALOGY, METALLURGY, AND CERAMICS		317
Geology and Geophysics	1968	
Metals and Metallurgy	1971	
Minerals and Mineralogy	1980	
PHYSICS		319
Cosmic Radiation and Mesons	1989	
Instruments	2011	
Isotopes	2013	
Isotopes Separation	2014	
Mass Spectrography	2016	
Measuring Instruments and Techniques	2019	
Neutrons	2040	
Nuclear Properties	2049	
Nuclear Reactors	2061	
Nuclear Transformation	2062	
Particle Accelerators	2067	
Radiation Absorption and Scattering	2073	
Radioactivity	2080	
Theoretical Physics	2100	
AUTHOR INDEX		A
SUBJECT INDEX		C
NUCLIDE INDEX		K
FOREIGN GEOGRAPHIC INDEX		L
PUBLISHED DOCUMENTS INDEX		M
NNES ANNOUNCEMENT		N

DOCUMENTS REFERENCE LIST

Vol. 4 No. 7

U. S. ATOMIC ENERGY COMMISSION DECLASSIFIED DOCUMENTS

Document	Title, Author	Abstract
AECD-2769	Behavior of Uranium at the Dropping Mercury Electrode in the Presence of Complexing Anions. II. Bicarbonate and Carbonate Media. W. F. Neuman.	1906
AECD-2770	Repeated Intraperitoneal Injections of Uranyl Nitrate. A. G. Dinse, T. B. Barnett, H. C. Hodge, and E. A. Maynard.	1908
AECD-2771	Age versus Toxicity. E. A. Maynard.	1909
AECD-2772	Effect of a Single Dose of Uranyl Nitrate. W. L. Downs, E. A. Maynard, and H. C. Hodge.	1910
AECD-2773	One-year Feeding Test. Serial Study of Uranyl Nitrate. E. A. Maynard, T. B. Barnett, W. L. Downs, W. F. Neuman, and H. Hodge.	1911
AECD-2774	Two-year Feeding Test. Uranium Dioxide. E. A. Maynard, W. L. Downs, and H. C. Hodge.	1912
AECD-2775	Two-year Feeding Test. Uranium Tetrafluoride. E. A. Maynard, W. L. Downs, and H. C. Hodge.	1913
AECD-2776	Two-year Feeding Test. Uranyl Fluoride. E. A. Maynard, W. L. Downs, and H. C. Hodge.	1914
AECD-2777	Two-year Feeding Test. Uranyl Nitrate Hexahydrate. E. A. Maynard, W. L. Downs, and H. C. Hodge.	1915
AECD-2778	One-year Feeding Experiments on Dogs. E. A. Maynard and H. C. Hodge.	1916
AECD-2779	Introduction. [Chronic One-year Uranium Compounds Inhalation Studies.] H. E. Stokinger.	1917
AECD-2780	Special Methods and Procedures. Establishment of Dusty Atmospheres. [Chronic One-year Uranium Compounds Inhalation Studies.] H. E. Stokinger.	1918
AECD-2781	The Effects of Exposure of Rabbits and Rats to Inhalation of Uranium Dioxide at 22Mg/M^3 Concentration and 0.5 μ Particle Size. H. B. Wilson and G. Sylvester.	1921
AECD-2782	The Relation Between Mean Particle Size and the Toxicity of Particulate Uranium Dioxide. H. E. Stokinger.	1922
AECD-2783	The Mechanism of Action of Uranium on Cells. A. Rothstein, R. C. Meier, L. Hurwitz, H. L. Berke, and C. Larrabee.	1924
AECD-2784	Suggested Maximum Allowable Concentration of Insoluble Uranium Compounds in Air. H. C. Hodge, H. E. Stokinger, W. F. Neuman, W. F. Bale, and A. E. Brandt.	1925

DOCUMENTS REFERENCE LIST

Document	Title, Author	Abstract
AECD-2785	Suggested Maximum Allowable Concentration of Soluble Uranium Compounds in Air. H. C. Hodge, H. E. Stokinger, and W. F. Neuman.	1926
AECD-2786	Urinary Uranium as a Measure of Exposure Hazards. W. F. Neuman.	1927
AECD-2787	The Effects of Uranium on Plants. A. G. Dinse	1928
AECD-2788	Special Materials. Inhalation Toxicity Studies of Boron Halides and Certain Fluorinated Hydrocarbons. Short-term Feeding Study with Cobalt Fluoride in Rats. Determination of Boron Halides in Air. H. E. Stokinger.	1929
AECD-2789	Summary [of NNES Div. VI, Vol. I, Chap. 19-28]. H. C. Hodge.	1930
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AECU-652	The Chemistry of Ruthenium; Annual Report Covering the Period June 1, 1948, to August 31, 1949. M. Kilpatrick, M. L. Kilpatrick, R. C. Vogel, and E. H. Kobish.	1952
AECU-667	The Isolation of Micro-Quantities of Uranium by Precipitation with Protein Prior to the Fluorometric Determination of Uranium. A Detailed Study of the Factor Involved. Nathan Glover.	1907
AECU-668	Discussion and Interpretations. [Chronic One-year Uranium Compounds Inhalation Studies.] H. E. Stokinger.	1919
AECU-669	Summary and Conclusions. [Chronic One-year Uranium Compounds Inhalation Studies.] H. E. Stokinger.	1920
AECU-671	Calcium Exchange as the Mechanism for Adsorption of the Radioactive Isotope by Bone. W. F. Neuman.	1923
AD-169(O)	Calibration of Weston and Ansco-Sweet Density Standards. P. J. Harris.	2019
AD-178(B)	The Effect of Exercise upon the Lethality of Roentgen Rays for Rats. D. J. Kimeldorf, D. C. Jones, J. L. Lee, F. A. Gonzalez, and M. C. Fishler.	1838
GEPM-17	Fundamental Research in Physical Metallurgy; Fourth Quarterly Progress Report. J. H. Hollomon and D. Turnbull.	1971
GEZR-5	Development of Zirconium Base Alloys. Fourth Quarterly Report. R. W. Hennig and J. D. Nisbet.	1972
M-4452	Health Physics Applied Training Course. Training Lecture Series Nov. 9, 1948, through Feb. 9, 1949. Oak Ridge National Laboratories.	1851
MITX-4	Solid Solutions and Grain Boundaries. Technical Progress Report No. 2, Scope II. B. L. Averbach, L. Seigle, and M. Cohen.	1973
MITX-5	Solid Solutions and Grain Boundaries. Technical Progress Report No. 3, Scope II. B. L. Averbach, L. Seigle, and M. Cohen.	1974
MITX-6	Solid Solutions and Grain Boundaries. Technical Progress Report No. 4, Scope II. B. L. Averbach, L. Seigle, and M. Cohen.	1975
NYO-103	A Simplified Geiger-Mueller Counter Circuit. H. D. LeVine.	2020
ORNL-394	The Blackening Effect of Neutron and Gamma Radiation on DuPont 552 and Eastman V-120 Film. B. Kalmon.	2021

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ORNL-396	The Production of Sodium-Formate-C^{14} by the Lithium Borohydride Process. J. G. Burr and H. E. Heller.	1958
ORNL-481	Physics Division Quarterly Progress Report for period Ending September 25, 1949. A. H. Snell and E. O. Wollan.	1982
ORNL-486	A Simple Low Drift Electrometer. F. M. Glass.	2022
ORNL-524	Measurement of Poisson's Ratio of Beryllium with Electric Strain Gages. H. C. Savage.	1976
ORNL-589	Fast Neutron Count-rate Dosimetry. G. S. Hurst.	2040
RPIB-3	Solvent Extraction of Inorganic Ions; Third Quarterly Progress Report. L. G. Bassett, S. E. Wiberley, J. Savolainen, H. M. Clark, and S. Ross.	1957
UCLA-47	The Strontium Content of Human Bones. R. M. Hodges, N. S. MacDonald, C. McArthur, P. Spain, F. Ezmirlian, R. Nusbaum, and R. Stearns.	1835
UCRL-445	Production of Mesons by X-rays. E. M. McMillan, J. M. Peterson, and R. S. White.	1989
UCRL-459 (Rev.)	The Lifetime of the Positive π Meson. E. A. Martinelli and W. K. H. Panofsky.	1990
UCRL-525	Calculation of Gas Viscosity as a Function of Temperature. L. A. Bromley.	1983
UR-99	"Hemolytic" Effect of Radiation. R. W. Davis, N. Dole, M. J. Izzo, and L. E. Young.	1839
UR-100	Experiments with Paper Chromatography of the Animal Phospholipids. J. O'Leary and W. F. Neuman.	1959
UR-101	Metabolic and Cardio-Respiratory Studies on Patients with Beryllium Granulomatosis. C. Waterhouse, E. H. Keutmann, J. W. Howland, and R. A. Bruce.	1931

BIOLOGY AND MEDICINE

1835 The Strontium Content of Human Bones. Robert M. Hodges, Norman S. MacDonald, Clare McArthur, Patricia Spain, Florita Ezmirlian, Ralph Nusbaum, and Richard Stearns. UCLA-47, Nov. 9, 1949. 16p.

Spectrographic analyses for Sr were made on samples of parietal, vertebral, rib, and femur bone ash from 26 individuals varying in age from fetus to 75 years. In addition, similar analyses were performed on parietal, rib, and femur samples obtained from 12 cadavers all of which had been in a state of preservation since the year 1914. The Sr content of all fetus specimens lay in the range 0.015 to 0.019% (average 0.016%). The range for all other specimens, save one, was 0.016 to 0.044% (average 0.024%). One hydrocephalic child showed an abnormally high bone Sr level (0.054%). Within any given individual there were no significant differences in Sr content between parietal, vertebral, rib, or femur bone, although the Sr level of all these specimens may have been high or low with respect to the average level for all individuals studied. The Sr content of the bones of the 12 individuals who died shortly prior to 1914 was not significantly different from that found in the 1949 series. Thus, any major differences in dietary habits in the two time periods were not reflected by the present data. It is concluded that Sr is a constant, though not necessarily essential, component of human bone. 12 references. (auth)

1836 Apparatus for Measuring Radioactivity in Histological Preparations. J. Möllerström, O. Lindberg, and H. Holmgren. Acta Anat. 7, 244-7(1949).

A method is described for measuring radioactivity in tissue preparations which consists of placing the frozen, vacuum-dried tissue on a microscope stage; the microscope objective is replaced by a Geiger-Mueller tube and a perforated lead shield is interposed between the tissue. The Geiger-Mueller tube enables one to determine the radioactivity in a localized field. Details are given of the construction of the apparatus.

1837 Multiple Manual Register for Differential Leucocyte Counts. C. Sanders and A. E. Bennett. Atomic Energy Research Establishment Report No. AERE-Med/R-434, Oct. 1949. 6p.

A Multiple Manual Register for differential leukocyte counts is described. The register incorporates 13 independent keys arranged in 3 groups of 4, 5, and 4 respectively, the middle 5 keys are numerically lettered for the Arneth count. A bell signals each time that a total of 100 cells is registered. The adaptability of this register for other purposes than differential leukocyte counts has been suggested. (auth)

1838 The Effect of Exercise upon the Lethality of Roentgen Rays for Rats. D. J. Kimeldorf, D. C. Jones, J. L. Lee, T. A. Gonzalez, and M. C. Fishler. Naval Radiological Defense Laboratory Report No. AD-178(B), Dec. 12, 1949. 10p.

Adult male rats were subjected to exhaustive exercise (swimming) following irradiation, and the lethality rate was determined. It is apparent that the lethality of roentgen rays at the doses studied (600r, 700r, 860r) is increased by the repeated performance of vigorous exercise following irradiation. It is suggested that the increased mortality observed with animals exercised after irradiation provides additional evidence that radiosensitivity is related to metabolic level. 11 references. (auth)

BIOLOGY AND MEDICINE

1839 "Hemolytic" Effect of Radiation. R. Wendell Davis, Nieves Dole, Mary Jane Izzo, and Lawrence E. Young. UR-99, Nov. 15, 1949. 19p.

Four renal-bile fistula dogs were exposed to total body radiation in single doses of 150 roentgens (1 dog) and 250 roentgens (3 dogs). The excretion of bilirubin in the urine by each of the 4 dogs increased significantly during the first or second week following exposure. Possible sources of the increments of bilirubin output are discussed and it is considered that accelerated destruction of mature erythrocytes could be neither established nor disproven by these experiments. It is considered likely that some bilirubin is derived from destruction of partly hemoglobinized normoblasts in the marrow. It is also suggested that somewhat more than the normal portion of the total bilirubin excretion might stem from hemoglobin precursors if such molecules should be less successfully incorporated into erythroid cells after radiation. The morphology of the red cells did not appear to be altered in any of the irradiated dogs, and serial measurements of osmotic and mechanical fragility of the erythrocytes revealed no significant alterations after radiation in the 2 dogs tested. Reticulocytosis and erythrophagocytosis could not be detected in smears of venous blood prepared after exposure. Ten milliliter aliquots of heparinized blood from a normal human donor were exposed in-vitro to x-radiation in doses ranging from 10 to 20,000 roentgens. The osmotic and mechanical fragility of the red cells was normal when tested immediately after radiation and again after incubation at 37°C for 24 hr following exposure, except in the sample treated with 20,000 roentgens which showed slightly greater than normal increase in osmotic fragility after incubation. Rates of autohemolysis and glycolysis during incubation in-vitro were neither accelerated or decelerated by irradiation of the blood prior to incubation. It is emphasized that any alterations produced in erythrocytes in-vitro by very large doses of x-radiation may be unrelated to the effects, if any, which small doses have on mature red cells in-vivo. It is concluded that new experimental approaches must be utilized to determine whether radiation has a truly hemolytic effect on mature red cells in-vivo. 27 references. (auth)

1840 A Contribution to the Problem of Radiotoxins. J. Zacek. Spisy Lekarske Fakulty Masarykovy Univ. 22, 1-10(1948)(in Czech).

A leucopenia lasting several days was provoked by an injection of the suspension of washed rat eythrocytes, previously irradiated in vitro with x-rays; a suspension of untreated blood cells was found to be without such action. It is concluded that the effect of parenteral injection of radiotoxins is the same as that provoked by direct irradiation of animals with x-rays.

1841 Effect of Whole Body X-radiation and of Intraperitoneal Hydrogen Peroxide on Mouse Liver Catalase. Robert N. Feinstein, Carrie L. Butler, and Daniel D. Hendley. Science 111, 149-50(1950) Feb. 10.

Carworth Farm male mice fed on a standard diet was x-rayed at the rate of 17 r/min for a total dose of 800 r; hydrogen peroxide was also injected in the amount of 340 mg/kg as an approximately 4% solution. Other mice the same age were injected with 0.2 ml of normal saline and served as controls; untreated mice also served as controls for the irradiated group. Liver catalase and protein were determined. It was found that the x-rays in vivo reduced the liver catalase; the intraperitoneally injected hydrogen peroxide also reduced the mouse liver catalase. It is concluded that the x-rays produce toxic hydrogen peroxide throughout the body, and simultaneously damage the body's chief protection against this agent. It is stated that the possibility does exist, however, that the hydrogen peroxide formed by the x-radiation is the agent actually responsible for the catalase destruction. This work has been temporarily interrupted by an unexplained reduction in liver catalase and increase in peroxide sensitivity among the authors' colony of mice.

1842 Effect of X-radiation on Trypanosoma Cruzi. John Emmett. J. Parasitol. 36, 45-7(1950) Feb.

Virulent cultures of trypanosoma cruzi in a medium were irradiated by x-ray doses of 10,000-100,000 r from a 180-kv machine using two unfiltered tubes and at a target distance of 14.8 cm; with this apparatus 10,000 r could be delivered in about 5 min. After varying exposures, 0.5 cc amounts of the cultures were immediately injected intraperitoneally into white mice weighing about 10 g; nonirradiated cultures were injected into control animals. It was found that with dosages up to 100,000 r the trypanosomes remained viable and morphologically unchanged; however, from 10,000 r upwards, a definite decrease in infective power of the organisms was induced. The earliest infection in an experimental animal was on the 5th day, but the majority of the animals did not become positive until several days later, as compared with positive control animals on the 4th to the 7th day. Subcultures from the 100,000 r cultures were allowed to grow a week, checked for motility and numbers, and injected into mice; the approximate number of organisms was somewhat decreased from controls. It is concluded that the radiosensitivity of trypanosoma cruzi parallels that of T. gambiense and T. brucei, but it is noted that the T. gambiense organisms became noninfectious after lower irradiation (12,000 r).

1843 The Effects of Ionizing Radiations on the Cell Nuclei of Experimental and Spontaneous Tumors. L. Cusmano. Tumori 23, 63-85(1949)(in Italian).

The behavior of the nuclei of malignant cells was studied in benzpyrene sarcomas of rats after x-ray irradiation and in uterine cancer of women after radium therapy. In both types of cases, the tumors showed a rapid decrease of the proliferating A cells, a temporary increase of hyperploid A cells and an increase of sublethal B cells.

1844 The Indirect Effect of X-rays on the Heart and Circulation in Man. Gerd Bedürftig and Günther Grüssner. Strahlentherapie 78, 445-58(1949)(in German).

In 60 patients (20 with mammary carcinoma of the right side, 20 with mammary carcinoma of the left side, 10 with bronchial carcinoma, and 5 each with carcinoma of the esophagus and tumor of the mediastinum), who were subjected to x-ray treatment, the pulse and blood-pressure before and after treatment with x-rays were measured and electrocardiograms were taken. The daily x-ray dosage was 100 - 700 r and the total was 1,000 - 15,000 r, delivered in 10 - 20 sittings. The irradiation was administered by 160 - 170-kv machines, with filters of 0.8 mm Cu and 1 mm Al, at a focal distance of 40 cm, to areas of 10 × 15 cm or 8 × 10 cm. Eighty-five per cent of the patients showed changes in the pulse rate, usually a diminished frequency over 3 - 4 hr of up to 30 beats/min. The blood-pressure fell 20 - 30 mm Hg, in some patients 30 - 40 mm Hg, in the systole and 15 - 25 mm Hg in the diastole. All changes returned to normal and are attributed to a higher vagotomy after x-ray treatment of the thorax. Direct injury to the heart and circulation through therapeutic x-ray dosages has not been found. 57 references.

1845 Malignant Tumors of the Uterine Fundus Subsequent to Irradiation for Benign Pelvic Conditions. H. Speert and T. C. Peightal. Am. J. Obstet. Gynecol. 57, 261-73(1949) Feb.

The results of the study of 21 cases in which a malignant tumor of the corpus uteri was discovered subsequent to pelvic irradiation for presumably benign conditions (an incidence of approximately 8%) are reported. Histological examination proved 11 to be adenocarcinomata and 3 adenocanthomata. The incidence of a history of pelvic irradiation among patients with cervical carcinoma was only 0.3%. X-ray treatment alone had been given to 4 of the patients, radium and x-rays to one, and radium alone to 16. The total dose for the latter was 350 - 1,500 mg hr in 10 cases, but was unknown in the others. The average time interval between irradiation and detection of the uterine cancer was 8.3 years. The evidence presented in this paper, it is concluded, falls short of proving that irradiation is carcinogenic for the human uterus.

1846 Observations on Disorders of the Thyroid Gland Associated with Exposure of the Suprarenal Glands to X-rays. K. A. Järvinen. Ann. Med. intern. fenn. 37, 227-44(1948).

Twenty-three cases in which x-rays were applied to the suprarenals, either intentionally in cases of hypertension and diabetes, or unintentionally during treatment of some other condition are described. The dosage was 180 - 1,728 r and more or less severe hyperthyroidism developed in 17 patients in 1 to 3 months, receding after 6 to 36 months, with only a slight goiter and a labile psychic state remaining. The role of the pituitary in the interaction of the endocrine glands is discussed.

1847 The Origin of Perichondritis in Irradiation of Tumors of the Larynx. Z. Hlasivec. Casopis Lekaru Ceskych 87, 680-2(1948)(in Czech).

The author finds that fractional, protracted irradiation of laryngeal tumors does not lead to perichondritis, unless there is infection present at the same time; where the tumor is infected there is increased irritation and spread of the infection which soon reaches the perichondrium. In tumors which become edematous after the first dose of irradiation, perichondritis is imminent, as in large ulcerated tumors. The author considers that good results can be expected in

only those tumors with a fibrous base; the irradiation increases the fibrosis and the nutrition of the tumor is reduced.

1848 Quarterly Research Report, School of Aviation Medicine, United States Air Force, Oct. 1 to Dec. 31, 1949.

Among the research projects currently being conducted at the USAF School of Aviation Medicine at Randolph Field, Texas, and described in this report are the following: The Antibody Response of Animals Exposed to X-radiation, Roland B. Mitchell, Gale H. Keyes, Dorothy T. Anderson, and A. W. Kimball. Isotopic Oxygen Consumption at Low Oxygen Tensions, J. E. Pickering, John M. Talbot, and H. Chinn. The first project was begun in order to investigate the possibility that adrenal cortical extracts may increase circulation antibody titers in animals with radiation-induced lymphopenias; it is almost completed. The second project aims to determine the actual depth of penetration of oxygen in tissue slices in the Warburg Respirometer under varying oxygen tensions, with the aid of isotopic oxygen; this project is 25% completed.

1849 The Radiobiological Course of a Reaction in the Vegetative Nervous System. Heinz Vieten. Strahlentherapie 79 13-58(1949)(in German).

The salient features of radiobiological reactions in the vegetative nervous system are summarized. With normal tonicity, there takes place after irradiation a moderate change equivalent to vagotonia after an initial sympathicotonia of short duration. In case of equilibrium disturbances, the radiation sensitivity of the vegetative nervous system increases approximately according to the law derived by Wilder (Klin. Wochschr. 2, 1889(1931)) for pharmacological stimulation, and adjustment always takes place after irradiation by x-rays. The reaction can in general be divided into two distinct phases. Reactions resulting from repeated irradiations can be considered a wavelike phenomenon; both the amplitudes of the individual reaction waves and their temporal duration are connected by certain regularities. Finally, it is stated that the course of a reaction depends on the dosage of radiation. An attempt is then made to interpret all these facts according to the hypothesis of Glauner (Strahlentherapie 62, 1(1938)), who assumes that radiation acts primarily in synaptic nerve cells by means of the acetylcholine which it liberates there, and according to the hypothesis of the author, who like Glauner assumes that radiation affecting the vegetative nervous system acts directly on synaptic ganglia, but considers this effect to be identical with the effect of radiation on cells or tissue in general. The paper is concluded by an extensive bibliography consisting of 101 items.

1850 The Reciprocal Vicinity Effect of Irradiated Tissues on a "Diffusible Substance" in Irradiated Tissues. Benjamin Jolles. Brit. J. Radiology 23, 18-24(1950) Jan.

In order to test the reciprocal vicinity effect in human irradiated tissue, a group of volunteers were given a dose of x-rays to two small areas of the skin separated by a varying width of untreated protected skin, and a single area was exposed to an equal amount of radiation on a symmetrical site. A 180-kv source was used, employing a 1.0 mm Cu

filter, and delivering the radiations at the rate of 39 r/min through a target distance of 30 cm. The upper half of the thighs were the sites selected for the exposure, but in a few cases the skin of the back was chosen because of the dimensions required. A single dose of 800 r was usually given, but in a few cases 600 r was delivered, and in one set of experiments, 1,000 r and 2,000 r were given at 140-kv with a filtration of 0.25 mm Cu + 1 mm Al. The degree of reaction produced was observed daily for the first two weeks, then every second day, then weekly and finally every two weeks. The reaction was significantly more marked when given over two small adjacent areas than over one area of skin at a symmetrical site. When, however, the separation between the two paired areas was greater than a certain minimum value, the reaction was equal to that seen on a single area. The hypothesis of a "diffusible substance" is tentatively suggested, and the protective role of normal surrounding tissues is discussed.

1851 Health Physics Applied Training Course. Training Lecture Series, Nov. 9, 1948 through Feb. 9, 1949. Oak Ridge National Laboratory. M-4452, nd. 286p.

This document is composed of lectures and notes on the following units which comprised the course: introduction, fundamental physics, application of physics to health physics, radiation detection methods, radiation detection techniques, applied health physics, and practical problems in the field of health physics.

1852 Cytological Aspects of Protection from Ionizing Radiations. A. Glücksmann. Brit. J. Radiology 23, 41-5(1950) Jan.

A review is presented concerning the cytological aspects of protection from radiation. The two main concepts of the mechanism of radiation action on cells and the radiation effects on germ cells and somatic cells are briefly discussed. The target theory of the biological action of ionizing radiations explains the radiation effect on the assumption that ionization occurs in or in the immediate neighborhood of certain molecules which constitute a vital target. A hit on this target is assumed to produce changes such as cell death in bacteria and viruses, gene mutations, or simple chromosome breaks. The "intracellular poison" concept holds that radiation effects such as inhibition of mitosis are brought about by radiation chemical changes almost anywhere within the cell. Localization of radiation effects is secondary and due to a specific sensitivity of some cell constituent to radiation chemical products. The poison concept accounts for effects known to depend on the rate and fractionation of the radiation dosage. The mechanisms for the production of genetic effects are gene mutations and chromosome structural changes. The direct and indirect carcinogenic effects of ionizing radiations are described. It is concluded that until more fundamental information is available we can do no more than hazard guesses at the maximum permissible doses of radiation; our knowledge of cytological radiation effects is incomplete and further research is required, particularly with regard to the effects of chronic exposure to irradiation and to the mechanism of tumor induction by radiation.

1853 Medical Aspects of Protection from Ionizing Radiations. F. Ellis. Brit. J. Radiology 23, 28-34(1950) Jan.

A general survey of the problem of protection from the harmful effects of irradiation is presented. The accepted standard of tolerance dose, the relative importance of the maximum dose received and the volume dose as an occupational hazard, the effects of occupational radiation and their significance, the production of cancer through radiations, the effects of radiations on the gonads, the hematopoietic organs and the genes and the protection devices available are the topics discussed. The author offers the following points for consideration: (1) where there is no threshold of exposure below which no damage is done by any agent, it is difficult to decide where precaution should fit in; small dosages of radiation raise this problem. (2) It is also suggested that the blood count change is an adequate indicator of the effect of the radiation sustained by the dividing cells of the hematopoietic system. Radiation protection, concludes the author, ought to extend primarily to protection from the development of leukemia or other forms of cancer and from the development of aplastic anemia.

1854 Protection Against Neutrons. Hermann Muth. Strahlentherapie 78, 551-62(1949)(in German).

This is a review article devoted to a theoretical as well as practical discussion of protective measures against neutrons. Shielding by water tanks is mentioned briefly, and shielding by concrete walls described in detail. It was found possible, by adding the substance "Pandermit" and "Rasorit" which contain bound water, to increase the hydrogen content of the concrete, which nevertheless had still the required strength and structural characteristics. Water content up to 10% by weight of concrete was achieved. A theoretical discussion is given of the intensity of the neutrons traversing a wall, and of their biological effect. A plan is shown of a proposed high energy installation (3 Mev) to be used for biophysical work, with all the protective measures (concrete walls, earthworks, brickwalls, etc.) shown in detail.

1855 Radiation Hazards—Invisible but Real. Consumers' Research Bulletin 25, 24-6(1950) Mar.

This discusses the testing of a static charge eliminator for phonograph records which used polonium. Amount of radiation from the device compared in intensity to that from the luminous watch dial. If properly handled, there should be no radiation hazard.

1856 The Radiation Hazards of Radiotherapeutic Staff. John R. Nuttall. Brit. J. Radiology 23, 35-40(1950) Jan.

The subject of protection from ionizing radiations is discussed from the point of view of the radiologist. The three main causes of skin damage from radiation are: repeated exposure of the hands to a beam of x-rays, such as that encountered in removing foreign bodies or setting fractures under a fluorescent screen; handling radium containers; and contamination from radon. The changes in the skin are described and consist of erythema around the nail beds, followed by hardening and cracking of the nails and the skin, and necrotization; the production of cancer usually occurs in the region of the most severe radiation damage, but the author has seen multiple lesions of the face of workers with serious hand damages. The hematopoietic effects and the radiation effects on the reproductive organs are outlined

and presented. The author concludes that the hematopoietic changes remain the major danger to the radiological workers, the observed higher incidence of leukemia in radiologists indicating this; reduction of the dosage to the gonads is also concluded to be one of the major objects of radiation protection. The actual danger to the operator should be weighed against the usefulness of the form of treatment proposed.

1857 Radioactive Waste Disposal—How Will It Affect Man's Economy? Kenneth G. Scott. Nucleonics 6, 18-25(1950) Jan.

The author describes the waste disposal problem faced by the growing number of public institutions, such as the University of California Medical Center for example, which use radioactive isotopes. Such wastes cannot be eliminated through sewage systems because of the high radioactive concentrations which would result in the sewage filter cake which is often used for fertilizer. The disposal methods recommended by the AEC are: dispersion in media such as air or water, confinement and dilution in materials such as concrete, or confinement in storage tanks after the volume of the waste has been reduced. These different methods are compared, and the disposal of wastes in the oceans is discussed in some detail.

1858 Status and Development of Protection Against Radiation. M. Dorneich and R. Jaeger. Strahlentherapie 78, 569-86(1949)(in German).

According to the author biological damage through radiation can be almost completely avoided if the proper precautions are observed. A complete list is given of the protective measures used in Germany, as listed by the German Norm Committee for x-ray and radium work, as of October, 1948. Pertinent information is furthermore summarized in a number of tables and graphs dealing with the ion density produced in tissue by various kinds of radiation, characteristic advantages and disadvantages of various protective measures, and safe dosages for continued work in the vicinity of sources of radiation. Finally a brief discussion is given of damage caused by the penetration of radioactive substances into the body, which cannot be determined by direct ionization measurements.

1859 The Treatment of X-ray Illness with Antistine. H. Fetzer and E. Werle. Strahlentherapie 78, 619-24 (1949)(in German).

Twelve patients who received x-ray treatment for various tumors and developed radiation sickness were treated with Antistine; x-ray illness is mainly considered an intoxication by histamine. The irradiation was administered by a 180-kv machine with a filtration of 0.75 mm Cu; the total dosage varied from 3,000 r to 12,930 r. According to the severity of their symptoms the patients were grouped as "medium" or "very ill." In all cases but one, where a recidivation of a carcinoma of the stomach was diagnosed, relief was registered during the first few days; 3 patients out of 4 of the "very ill" group became well. The effect of Antistine as a histamine-antagonist and its influence on the cholinesterase-acetylcholine system is referred to. 18 references.

1860 Adenocarcinoma of the Uterine Neck. H. Limburg and K. Thomsen. Stuttgart, George Thieme, 1949. 87p. (in German).

BIOLOGY AND MEDICINE

This brief book comprises the results of the histological and clinical study and the treatment of 665 cases of carcinoma of the neck of the uterus from the University Clinic of Hamburg-Eppendorf. Those cases classified as in stages one and two were considered operable while more advanced cases were treated with radium and x-rays. Of 29 cases treated by the radiotherapeutic method, 6 are cured; the operative cure rate was 40.9%.

1861 Cancer of the Breast. John Day Peake and Marshall Eskridge. Mississippi Valley Med. J. 71, 216-17 (1949) Nov.

The results of the treatment of different stages of cancer of the breast with radiation therapy are described. It was found that in cancer with only a few involved axillary nodes, skin free and tumor free, a dose of 3,000-5,000 r may be used successfully; a combined surgical and x-radiation technique increases the cure rate 8-30% over that achieved by surgery alone. With advanced inoperable cancer, doses of 1,500-4,000 r depending on the size of the lesion, are given. It was found that when cancer of the breast is detected in the early stages and treated properly, a 75% cure rate may be achieved; cancer of the breast with involved axillary nodes may yield a 20-45% cure rate. Advanced cancer may be treated palliatively with x-ray therapy and hormones, while recurrent breast cancer and cancer in the aged can best be treated by x-ray therapy alone.

1862 Carcinoma of the Tongue. F. Jacobsson. Acta Radiol. Suppl. 68, 190p. (1948).

An account of 277 cases of carcinoma of the tongue treated at the Radiumhemmet, Stockholm, with radiotherapy is presented. The teleradium and electrocoagulation methods of treatment are described in detail; the teleradium total dose was about 5,500 r delivered over 14 to 17 days. The 5-yr cure rate calculated on all the treated cases was 29.9%. In 24 cases of metastases treated by irradiation and block dissection, the 5-yr cure rate was 28%. Radionecrosis of the tongue and radio-osteomyelitis complicated the cures in some cases.

1863 The Choice Between Surgery and Radium in the Treatment of Carcinoma of the Cervix, Stage I. S. Laborde. La médicine 29, 9-11(1948)(in French).

The author quotes a cure rate of 70 to 75% in stage I of carcinoma of the cervix following radiotherapeutic treatment, which surgery cannot equal, but considers the following indications for surgery in this stage: anatomical reasons preventing proper distribution of radium; failure of regression of the tumor after a single application of radium; younger age group (the superiority of surgical results in these cases is doubtful); infiltrating type of growth, which is generally not very radiosensitive; and, adenocarcinoma of the cervix invading widely and involving the body of the uterus. Histological examination of cases of adenocarcinoma after treatment by radium showed no evidence of neoplastic growth in any specimen. The opinion favoring secondary hysterectomy after radium treatment is based on the fact that neoplastic growth has been found in the uterus after radium treatment.

1864 Clinical Evaluation of Methods of Treatment of Carcinoma of the Lower Lip. A. I. Rakov. Khirurgiya No. 2, 23-47(1949) Feb.(in Russian).

BIOLOGY AND MEDICINE

Of 408 cases treated at the Institute of Oncology in Leningrad from 1937-1949, 218 cases received x-ray treatment. Formerly, massive doses were used for the primary lesion, but in recent years a fractionated method was found superior and was generally employed; resistance to x-ray therapy was found in 10 to 15%. Radium therapy was used in 19 cases; distant irradiation was abandoned in favor of implantation of radium needles and 13 cases in which such treatment was used are reported cured. Operative treatment consisted in wedge excisions in a few early cases, and more radical rectangular excisions in the majority of cases; of a total of 32 operations, 27 produced cure. The author concludes that x-ray therapy should be given preference in the treatment of the first three stages of the disease, since it is easy, painless, and gives the best cosmetic and functional results. For x-ray resistant cases implantation of radium needles is concluded to be the best hope of cure; operation should be reserved for cases resistant to irradiation.

1865 Clinical Radiation Dosage. III. A Biological Factor in Radon and Isotope Dosage. Lionel Cohen. Brit. J. Radiology 23, 25-7(1950) Jan.

It has been shown that when relatively short-lived radioactive sources are used in therapy, there is a critical interval of time during which the biological efficacy is approaching a maximum; clinical dosage prescriptions must be calculated for this critical interval; doses based on longer or shorter time intervals are considered likely to prove excessive. A formula is given whereby the critical biological interval can be determined for isotopes having various half-lives; a nomogram relates tissue tolerance and cancer lethal doses to the half-life of the γ ray source used. It is suggested that permanent implants of moderately long-lived sources may have certain clinical advantages.

1866 Combined X-ray and Short-Wave Therapy of Abscesses of the Sweat Glands. Günter von Pannewitz. Langenbeck's Arch. u. Deut. Z. Chir. 263, 383-7 (1950) (in German).

Over 300 patients with abscesses of the sweat glands were treated with a combined method of x-ray irradiation and short-wave therapy. The irradiation was delivered by an 80-kv machine, with a filter of 4 mm Al. The total x-ray dosage of 450 r, administered in two sittings, was deemed essential for the hair epilation. It was followed by short-wave therapy until complete healing was obtained. In this way it was possible to reduce the formation of recidivations from 10% to 2%.

1867 Concerning the Possible Influence of X-ray Therapy on Abdominal Diseases, Especially Ulcer of the Stomach and of the Duodenum. R. Birkner and W. Werner. Strahlentherapie 79, 81-92(1949)(in German).

The conception of the central role assigned to the nervous system in pathogenesis has caused a far-reaching change in medical thinking. In radiology the interest in functional radiation is considered to be one promising practical outcome of this new conception; theoretical problems, literature, and methods in this field of radiation are discussed. The irradiation of the skin regions of Head's field was carried out on patients with ulcers of the stomach and duodenum at a short distance (5 cm) with a 60-kv machine and a 4 mm Al

filter by means of a special tube with a circular opening of 12 cm in diameter. Relief was brought after two sittings consisting of 100-200 r at each sitting, and complete relief from all symptoms was obtained after 5 to 6 radiations. Though parts of the ulcer could still be found weeks after the radiations, the patients remained symptom-free and could work. Good results were also obtained after skin irradiations where such illnesses as colitis, ulcerosa sigmoidea, cholecystopathia, chronic appendicitis, and chronic gastritis were present, which are partly due to disturbances in the neurovegetative system. 40 references.

1868 Concerning the Removal of Troublesome Hypertrichosis in the Beard Area of Women through Local Short-Distance X-ray Therapy. Wolfgang Knierer. Strahlentherapie 79, 257-60(1949)(in German).

The hairy area was irradiated with 1,000 r doses on two consecutive days at a target distance of 5 cm, through a 0.1 mm Cu filter. The results were good in most cases under observation for 30 months. Disadvantages of the method are concluded to be the small field area and the technical difficulties in focusing.

1869 Concerning X-ray Therapy of Bronchio-Carcinoma. R. Haubrich. Strahlentherapie 79, 233-42(1949)(in German).

X-ray therapy in 50 cases of bronchio-carcinoma failed to provide permanent healing or 5-yr successes. For untreated patients the life expectancy after the first manifestations of the desease is about 5 to 6 months; x-ray dosages under 6,000 r do not lengthen the life of the patient, but dosages from 7,000 to 9,000 r lengthen the life about 1 to 2 months and high dosages of over 9,000 r about 5 to 6 months. X-ray therapy changes the course of the illness only in a quantitative way. Patients treated early have no longer life expectancy than those treated later if equally high dosages are administered, but the general condition of the patient is an important factor in the results. Sporadic metastases, atelectasis and a well-defined pleural exudate are not contraindications and do not diminish success within the stated limits. 14 references.

1870 Concerning X-ray Therapy of "So-called" Prostatic Hypertrophy. Bruno Wolf. Strahlentherapie 79, 201-6(1949)(in German).

Ninety cases of prostatic hypertrophy were treated with x irradiations delivered by a 200-kv machine, with a filtration of 1.0 cm Cu, to a 10 × 15 cm field, at a target distance of 40 cm; the 3-field method was used. After 2 to 120 months, 89 cases were healed or improved. X-ray therapy for all cases of prostatic hypertrophy is advocated in view of the relatively high mortality rate after operation. 15 references.

1871 Concerning X-ray Therapy of Tuberculous Lymph Nodes of the Neck. Karl Umbach. Strahlentherapie 78, 403-410(1949)(in German).

One-hundred and forty patients with tuberculosis of the glands of the neck were treated with x-rays. One course consisted of 6 sittings every third or fourth day with single doses of 150 r for each field (back and front). If softening of the gland began before treatment, 300 r was then administered. If the glands were very large, but it was thought

BIOLOGY AND MEDICINE

advisable to avoid the softening process, small doses of 50 to 100 r per field were given, and for older and harder glands, 200 r per field were given. Irradiation was delivered by a 180-kv machine, at a target distance of 30 cm and with a filter of 0.5 mm Cu. Of 72 cases (54.5%) where perforation occurred, 83.6% were healed following the first course of therapy, 15 cases (24.6%) after a second course, and 1 case (1.6%) after a third course of x-ray therapy. In 61 cases (45.5%) where no perforation occurred, 73.8% were healed initially, while 9 cases (20%) responded after a second course, and 1 case after a third course; 47.9% of the perforated cases were subjected to a combined x-ray and surgical treatment with very good results. In cases of perforation no interruption of the x-ray therapy was made. It is noteworthy that the process of healing is slowed down from 2 to 12 months in perforated cases as against 1 to 3 months in nonperforated cases.

1872 Concerning X-ray Treatment of Local Recidivations and Metastases in Operated Mammary Carcinoma. R. Bauer. Strahlentherapie 78, 527-32(1949)(in German).

The treatment of recidivations in the scar and local metastases of the skin after operation of mammary carcinoma is summarized. Short-distance radiation is combined with tangential deep radiation of the thorax. Recidivations in the scar receive a caustic dosage of 5,000 to 6,000 r, whereas for metastases of the skin 3,000 to 4,000 r are considered sufficient. Where metastases of the glands are formed, daily doses of 200 r are applied, up to a total of 3,000 ro 4,000 r. The possible role of the female sex hormone as a factor in the formation of mammary carcinoma are discussed.

1873 Concerning X-ray Treatment of Pyogenic Infections. Gerd Eilermann. Strahlentherapie 78, 609-18(1949)(in German).

One hundred and seventeen cases of furuncles, mostly of the head region, 7 cases of abscesses and phlegmons, 50 cases of abscesses of the sweat glands and 34 cases of panaritium were subjected to x-ray treatment from a 180-185-kv machine, at 30-40 cm target distance with a filter of 0.5 mm Cu. At the first or only treatment 75-100 r was given; if a second sitting was necessary this dosage was reduced to 75 or 50 r. Usually the total dosage lay between 50 and 200 r. Results were very encouraging; 105 cases (96.6%) of furunculosis, 5 cases (71.4%) of abscesses and phlegmons, and 38 cases (76%) of sweat glands abscesses were healed or improved. Of the 34 cases of panaritium, 29 (85.2%) were healed without surgical treatment. An initial decline after treatment, owing to the formation of an acidotic condition, soon afterwards gave way to improvement and relief of pains. 18 references.

1874 Laryngeal Cancer. Indications for Treatment and Results. C. Henschel. Rev. méd. Liège 3, 273-9 (1948)(in French).

The author gives the results obtained by irradiation of intrinsic laryngeal cancer and compares these with the results that can be obtained by surgery. The radiation technique consisted of total doses of 6,000 to 7,000 r delivered over a period of 6 to 8 weeks to lateral fields of 50 sq cm by a 200-kv machine with a filtration of 2 mm Cu and at a

target distance of 80 cm; individual doses were 200 r/field. Of 80 cases treated by this irradiation method, 20 survived 5 years, 2 survived 4 years, 8 for 3 years, 9 for 2 years, and 41 died. Surgery yielded a 35% 5-year survival rate in the operable cases.

1875 The "Law of Initial Values" in Functional X-ray Therapy. Heinz Vieten. Strahlentherapie 78, 429-40(1949)(in German).

Starting from the "law of initial values" established by Wilder (Klin. Wochschr. 2, 1889(1931)) for pharmacological stimulation, and taking into account similarities between this stimulation and that through radiation, the same law was arrived at for biological reactions after x-ray treatment of the vegetative nervous system. Over 250 radiation series on adults and children were carried out; adults received radiation through 8 fields and children through 5 fields, at 75 r/field. Changes in the eosinophil, lymphocyte, blood-sugar, sodium, and calcium values were taken as criteria for changes in the tonus of the vegetative nervous system. The results show that with small initial values, the increase is great and the decrease is small; whereas with large initial values, the increase is small and the decrease great. The positive change (increase) can be expressed as an exponential function of the initial value and the negative change (decrease) as a parabolic function of the initial value.

1876 The Nasopharyngeal Radium Applicator in the Treatment and Prevention of Deafness. E. J. Smith and E. E. Scharfe. Can. Med. Assoc. J. 62, 150-6(1950) Feb.

The treatment of deafness, where caused by nasopharyngeal lymphoid tissue, by irradiation with a nasopharyngeal radium applicator is described. The standard technique employed was the irradiation of each side of the nasopharynx from a monel metal applicator containing 50 mg of radium sulfate for 8.5 min; 3 treatments were usually given, at intervals of 2 or 3 weeks. Variable results were obtained, and it was found that the degree of success of the treatment depended upon the age of the patient and the duration of the symptoms prior to therapy. It is concluded that this form of therapy is not without potential danger and should not be used in deafness other than that due to Eustachian tube obstruction.

1877 Observations on Tuberculous Lymph Nodes under X-ray Treatment. Walther Henningsen. Strahlentherapie 78, 533-9(1949)(in German).

Of 180 patients who were treated with x-ray irradiation for tuberculous lymph nodes, the clinical history of 6 is described. No details on the x-ray treatment are given except for the cases where the process remains closed; here dosages of 120 to 180 r were sufficient, but dosages under 60 r did not show effects on the gland. The treatments stretched over periods from 10 months to more than 2 years and, intermittently, even longer than 6 years. The occurrence of recidivations in operated cases and in those receiving only x-ray treatment was almost equal.

1878 On the Causality of Climacteric Molimina and Their Therapy with Small Dosages of X-ray Irradiation of the Mesencephalon. Rudolf Birkner and Johannes Trautmann. Strahlentherapie 79, 165-76(1949)(in German).

Seven patients suffering from various nervous climacteric symptoms were treated with small doses of x-ray in the region of the brain stem. The irradiations were delivered by a 180-kv machine, with a filtration of 0.5 mm Cu, at a target distance of 30 cm. Single doses of 50 r were administered 3 times weekly for total dosages of 175 r to 400 r. Patients under observation for 8 months were free, or almost free, from symptoms. The use of x-ray therapy in cases of post-war amenorrhea and lipophilic dystrophy is suggested. 60 references.

1879 On Malignant Tumors of the Oral Cavity and the Tonsil, with Special Consideration of the Outcome of Radiotherapy. M. J. Hämäläinen. Annales Chirurg. Gynaecol. Fenniae 38, 143-64(1949).

A survey is presented on 162 cases of malignancy of the oral cavity and tonsils treated between 1936 and 1943; the series comprised 46 cases of cancer of the buccal mucosa, 48 of cancer of the gingiva, 6 of sarcoma of the gingiva, 24 cancers of the soft and hard palate and 38 malignant tonsils. The methods of irradiation employed were: x-rays alone in 80 cases, teleradium alone in 12, a combination of both in 5, and 49 patients received additional radium by implantation or surface application. X-rays and electrocoagulation were given to 11 patients, radium implantation alone to 2, and electrocoagulation alone to 3 patients. A follow-up showed that 34.9% were free from disease after 3 years and 26.7% after 5 years.

1880 On the Treatment of Inoperable Carcinoma of the Genitalia with Partial Operation and Intra-abdominal Contact-Irradiation. A. Mayer. Strahlentherapie 78, 501-2(1949)(in German).

Twenty-seven cases of very advanced carcinoma of the female genitalia were treated with partial operation and intra-abdominal contact-irradiation with a high surface dosage and good protection of deeper-lying organs and tissues. Only four women lived longer than one year, two are living after three years, and one after five years. The author, however, sees some possibilities for a wider application of this combined method in cases of inoperable carcinoma of the bladder and of the rectum, since it seems to lengthen the life of the patient.

1881 Concerning Intra-abdominal Short-Distance Irradiation. H. Drescher. Strahlentherapie 78, 503-10(1949)(in German).

This article is an amplification of the report summarized in the preceding abstract (1880).

1882 Possible Techniques in Direct-Electron-Beam Tumor Therapy. W. H. Bostick. Phys. Rev. 77, 564-5(1950) Feb. 15 (Letter to the editor).

In view of the possible applications of direct electron beams from betatrons to the therapy of tumors, the author has made approximate calculations, layer by layer, of the scattering of electrons in water (which is practically equivalent to tissue) with the use of the expression (Heisenberg, Cosmic Radiation, New York, Dover Publications, 1946. p.27.) for the mean-square scattering angle $\langle \theta_1^2 \rangle = (K/E_1)^2 l_1$,

where E_i is the energy of the electron in Mev, K = 21 Mev, l_i the thickness of layer number i measured in radiation units, and where the angle $\left(\langle\theta^2\rangle\right)^{\frac{1}{2}}$ is required to be small. The radiation unit for water is 43 cm. The resultant mean-square scattering angle for n layers of tissue is then $\langle\theta^2\rangle = \left(\langle\theta_1^2\rangle + \langle\theta_2^2\rangle + \cdots \langle\theta_n^2\rangle\right)$. These calculations assume that the energy loss of the electron occurs entirely by ionization and follows the well-known variation with energy given by Bloch (Ann. Physik 16, 285(1933)). Results of this calculation are given for incident energies of 50 and 20 Mev. It is furthermore shown that the radial divergence of the beam can be reduced by the application of a magnetic field in the direction of incidence of the electrons. Finally, the possibility is discussed of making an incision to the tumor, inserting a tube to hold back the intervening tissue, and shooting the electron beam directly into the tumor, in which case the scattering of the electrons is unimportant.

1883 Preliminary Communication on the Intracavitary Irradiation of the Bladder Mucosa by Radioactive Isotope Solution. D. M. Wallace, R. J. Walton, and W. K. Sinclair. Brit. J. Urol. 21, 357-64(1949) Dec.

A short-lived radioactive isotope, Na^{24}, was used for intracavitary irradiation of ten cases of suspected or confirmed carcinoma of the bladder. The selection of the cases, the staff protection necessary and the technique of administration of the dosages are described. A catheter was inserted and filled with 150 ml of the radioactive solution (containing 200 mc of Na^{24}); γ-ray doses of 2,000 to 3,000 r were delivered to the bladder mucosa. All ten cases showed some evidence of regression; in seven, there was evidence of a mucosal neoplastic lesion, while one case demonstrated symptomatic relief without cystoscopic confirmation of regression. There was no loss of urinary control in any of the male cases treated, no proctitis, and no bleeding. It is stated that it is unconfirmed whether there is an adequate margin between the dose of radiation required to destroy the tumor tissue and the dose which will result in necrosis of the normal bladder wall. Infiltrative lesions cannot be treated by the technique described.

1884 Radiation in the Treatment of Tonsils and Chronic Infections. D. T. Quigley. Mississippi Valley Med. J. 71, 200-2(1949) Nov.

The treatment of tonsils and chronic infections by x-rays and radium therapy is discussed. The radium technique consisted of administering 30-50 mg of radium in an applicator through 1 mm of gold or platinum plus 3 mm of lead and 2 mm of steel; the radiation dosage is delivered for 3 to 16 hr, in tonsil work, to each side at the angle of the jaw simultaneously, or on succeeding days. In the 33 years since beginning the work, over half of the patients have reported satisfactory results, and in a late group since 1945 the favorable results totaled about 90%. It is concluded that the basis is now laid for the scientific, nonsurgical treatment of chronic sinus infection, chronic tonsil infection, enlarged lymph glands and the chronically infected scars that so often follow tonsillectomy.

1885 Radiation Results in Leukemia during the Last Ten Years. Horst Müller. Strahlentherapie 79, 193-200(1949)(in German).

Myelogenic leukemia (35 cases) and lymphatic leukemia (34 cases) were treated with deep x-ray therapy. The irradiations were delivered by a 160-175-kv machine, with a 0.5 mm Cu filter to a field area of 10 × 15 cm or 8 × 10 cm; a single dose was 100-150 r. In some cases a total irradiation of the body was given with a filtration of 1 mm Cu and at a target distance of 90 cm; only small doses of 25 r for a total dosage of 250 r were given. After this kind of therapy, the authors found the life expectancy to be 30.1 months for myelogenic, and 33.0 months for lymphatic leukemia, counted from the beginning of spleen and gland swellings. 19 references.

1886 Radiation Therapy with 20 Mev. R. Glocker. Strahlentherapie 78, 541-50(1949)(in German).

A review is given of work on the betatron and other high energy machines, particularly insofar as it applies to radiation therapy with energies up to 20 Mev. It is pointed out that depth-dosage curves for very hard x-rays show a maximum at a certain depth which is more pronounced and shifted toward greater depth with increasing hardness. This is due to the production of Compton electrons by the x-rays. Moreover, there is a decrease in the half-value thickness for energies exceeding 5 Mev which is caused by increased absorption through pair production. Finally, it is mentioned that irradiation with electrons rather than x-rays from high energy machines has the practical advantage of a more limited range of penetration for the same energy.

1887 Radioiodine Therapy in Graves' Disease. A Review. Mayo H. Soley and Nadine Foreman. J. Clin. Invest. 28, Pt. 1, 1367-74(1949) Nov. (See also NSA 1-250, 2-1278, 3-920.)

An attempt has been made to present the total experience, to date, in the treatment of thyrotoxicosis with radioactive iodine (I^{130}, I^{131}, or I^{127}). Although there are differences among various groups in the methods of treatment, the end results were found to be quite similar and compared favorably with already accepted forms of therapy. It is stated that the use of radioactive materials in clinical medicine brings with it the necessity for specially trained personnel, and strict attention to the potential hazards of radiation both to patients and to physicians. The author concludes that in this, the relatively young era of isotope application, progress must be made slowly and carefully. It is not unlikely, however, that radioiodine therapy ultimately will come into more general use. (auth)

1888 Radiotherapy of Laryngeal Cancer. M. Lenz. Anales med. cirurgía (Barcelona) 23, 448-9(1948) (in Spanish).

A total of 110 patients with laryngeal cancer were submitted to irradiation; in 42 the tumor was still locally present after irradiation and in 21 the larynx demonstrated edema at death; in 5 cases there was radionecrosis and in 11 cases growth was localized to the larynx. Twenty-three patients are free from clinical signs of cancer after 5 and 14 years. The author concludes that radiotherapy gives better results in undifferentiated tumors than in differentiated ones and that invasion of the arytenoid cartilage and metastasis to regional lymph nodes means bad prognosis. Concerning curability, radiotherapy of laryngeal cancer may be favorably compared with laryngofissure and cordectomy.

BIOLOGY AND MEDICINE

1889 Radium Dosimetry by Means of Very Small Ionization Chambers. Part I. Julius Ries. Strahlentherapie 78, 411-16(1949)(in German).

A general review is given of the various types of ionization chambers which have been used for radium dosimetry. Particular attention is paid to very small ionization chambers to be used in connection with the treatment of uterine carcinoma. The desirable characteristics of such small chambers are great sensitivity, possibility of insertion of the chamber into the organs (e.g., the bladder) of the patient, and simplicity of operation. A chamber fulfilling these requirements was constructed, in collaboration with the author, by Bomke and Eberle (Strahlentherapie 78, 417(1949)).

1890 Radium Treatment of Malignant Tumors of the Skin. Ernst Heinke. Med. Klin. (Munich) 44, 1407-9(1949) Nov. 4 (in German).

Ninety patients with angioma, 107 with basocellular carcinoma, and 13 with lupus carcinoma were treated with radiations delivered by 2 mg radium tubes in the form of moulages or by insertion into the tumors. In the first case, a filtration of 0.2 mm of platinum-iridium and 1 mm of brass was used; in cases where radium was inserted, a 0.2 mm gold filter was employed. The dosages varied from 300 to 400 r within 3 to 6 days, up to a total of 900 to 1,200 r, for the angioma cases; if only one treatment was given, no more than 1,000 r was applied and with babies up to 6 months of age, 3×300 r or 3×400 r was administered. In cases of basocellular carcinoma, the patients received 1,000 to 2,000 r every second or third day for a total dosage of 2,500 to 5,000 r. In cases of clavi under the sole of the foot, a dose of 2,000 r was considered satisfactory.

1891 Roentgenotherapy in Trigeminal Neuralgia. I. S. Trostler. Mississippi Valley Med. J. 71, 204(1949) Nov.

The radiation treatment, since 1920, of cases of trigeminal neuralgia consisted of doses of 166-200 r delivered by a 112-kv x-ray machine at 20 cm target distance and at weekly intervals to the Gasserian ganglion and painful areas in the face; the eyes, and eyebrows were protected with lead or lead rubber. The best results were achieved with patients who showed a definite reduction in the amount of pain after each treatment; none received more than 12 applications, mainly because of the danger of skin injury. Of 19 patients so treated, 11 demonstrated complete remission of the painful spasms, three cases showed definite reduction of the severity of the pain, and in five instances, no appreciable improvement was noticed.

1892 Roentgen Therapy of Tuberculous Glands of the Neck. S. Alam and M. A. H. Siddiqi. J. Indian Med. Assoc. 19, 94-6(1949) Dec.

The results of the treatment of about 70 cases of tuberculous glands of the neck with roentgen therapy are compared with the results obtained with more conservative therapy (surgery, etc.). The x-ray therapy cases were divided into two groups: cases demonstrating confluent masses with or without abscesses or sinuses (treated with a 300-kv source, 1 mm and 0.5 mm Cu filtration, at a distance of 50 cm for 10 min); and, cases showing small, discrete nodules or large, scattered swellings (treated at 85 kv with irradiation through a 3 mm Al filter, at a target distance of 20 cm and for 4.3 min periods). The total dosage delivered was 900 r over a period of 6 weeks; several courses of 900 r were frequently used. Of the 70 patients treated by x-ray therapy, 46 demonstrated good results while only 6 of 70 cases treated by conservative methods yielded good results.

BIOLOGY AND MEDICINE

1893 Roentgen Treatment of Lip and Skin Epitheliomas. H. Stech. Krebsarzt 10, 370-5(1948) Oct. (in German).

A total of 139 cases of superficial lip and skin epitheliomas, 2 of sarcomas and 2 of melanomas were treated by x-ray therapy from a Van der Plaats machine operating at 55 kv; the target distance was 2-4 cm. Various total and fractionated doses were given, some cases receiving single doses of up to 6,000 r; most cases received 300-600 r daily for a total dosage of 2,000-20,000 r. A total of 90 of the 139 epithelioma cases are symptom-free after five years; all of the sarcoma and melanoma cases, however, have died. The author recommends this type of therapy in place of radium, since the radiation time is shorter, the tissue dosage is more concentrated and the results compare favorably with those obtained by radium therapy.

1894 The Role of the Functional Factor of Prostatism in X-ray Irradiation. Heinz Vieten. Strahlentherapie 78, 471-6(1949)(in German).

The fact that the neuro-vegetative system controls all functions of the human body furnishes the basis for functional x-ray therapy. Since some of the symptoms in prostatism are nervously conditioned, 20 patients were treated indirectly, that is, the nervous system of the lower thoracic and upper lumbar region was subjected to x-ray treatment and not the prostate itself. The irradiation was delivered by a 175-kv machine, with a filter of 0.5 mm Cu, under deep x-ray irradiation conditions, 6 times within 3 weeks, at doses of 100 r; this is a very small dosage compared with dosages used in treating the adenoma of the prostate directly. As a result 14 patients were free from symptoms or greatly improved; 6 did not improve. This corresponds favorably with results obtained in direct radiation of the adenoma of the prostate with a high x-ray dosage.

1895 A Study of the Results of Roentgen Irradiation of Uterine Myoma. J. Miinalainen. Duodecim (Helsinki) 64, 433-9(1948)(in Finnish).

Among 85 patients treated with x-ray for uterine myoma, good results were obtained in 89.2%; two of the five cases with a submucous fibroid were later treated surgically. Three patients suffered from goiter before irradiation and were later submitted to thyroidectomy, two of whom died immediately after the operation.

1896 Therapy of Esophageal Carcinoma. G. Bonse. Strahlentherapie 78, 393-402(1949)(in German).

In four cases of carcinoma of the esophagus, the rotation-radiation method (as developed by du Mesuil at Marburg) was used; the conditions were those usually employed for deep x-ray therapy. The field area was 10×15 cm and the total site-dosage was 3,000-4,500 r. One patient survived 7.5 months, one is living after 10 months, and another after 6.5 months, but he shows continued growth of a stomach

carcinoma. It is concluded that the life expectancy of these patients is not longer than that of patients treated by other radiation methods; but the method described seems safer to the author than other methods, as far as homogeneity of site-irradiation, skin protection, and the general effect is concerned (if the field area is not too large). 46 references.

1897 Treatment of Local Skin Recurrences of Mammary Cancer. G. Tori and B. Franchi. Radiologia Sperimentale 2, 273-7(1948)(in Italian).

Local recurrences or distant metastases, observed as small isolated nodes, were irradiated with x-ray contact therapy (doses of 500-1,000 r, at 3-5 cm target distance, for a total of 10,000-15,000 r). There were no new recurrences in the irradiated areas (43 cases) but the final fate of patients suffering from recurrence of mammary cancer could not be altered by contact therapy. The author concludes that this treatment is indicated only as a supplementary means and is in no way destined to replace radium or ordinary x-ray therapy.

1898 Treatment of Warts. Gentz Perry. Mississippi Valley Med. J. 71, 190-3(1949) Nov.

The results of the treatment of various types of warts with radiation therapy are represented. A single dose of 1,300 r is usually given to warts of 1 cm in size, followed by another in two weeks if necessary; the voltages used are 80 to 140 kv, with inherent filtration of a half value layer of 1 to 5 mm Al. A total of 98% of these patients so treated were cured, with no unfavorable sequellae. Doses vary according to the size (the larger the wart, the smaller the total dosage), site, type of wart, and condition of the skin. In certain cases an unfiltered radium plaque may be used, being placed directly over an opening in the lead shield above the wart. It is claimed that warts treated by the methods outlined in this article do not recur.

1899 Twenty Years Experience in the Treatment of Cancer of the Mouth. F. Perussia. Rass. clin. sci. 24, 297-302(1948)(in Italian).

The indications for the employment of different radium and radiotherapeutic techniques for cancer of the mouth are discussed. Surgical removal is indicated for all adenopathies, even of dubious origin. It is stated that the most successful cases are cancers of the lip, which yielded cure rates of 50% after 3 to 12 years. It is concluded that the cure rates for the different sites are mainly dependent on the presence of glandular metastases.

1900 X-ray Equipment. Oswald Conrad Hollstein (to F. R. Machine Works, Long Island City, N.Y.). U. S. Patent 2,474,421, June 28, 1949. (See also NSA 4-1643).

A method is described of determining the area of a body to be subjected to irradiation by x-rays. A calibrated system of shutters is provided, which is used in conjunction with a source of ordinary light placed in the same position as the source of x-rays. Thus from the image formed by the ordinary light, one can determine the region that will be irradiated by x-rays. The invention is claimed to be suitable for use as a localizer as well as an intra-cavity or intra-oral x-ray unit.

BIOLOGY AND MEDICINE

1901 The X-ray Therapy of Abscesses of the Sweat Glands. Günter P. Krause. Strahlentherapie 79 253-6(1949) (in German).

Sixty patients with abscesses of the sweat glands were treated with x-rays; 3 to 4 doses, every fourth day, of 20 to 25% of SED (skin erythma dose) were administered. The healing rate was 90% and no recidivations occurred.

1902 X-ray Therapy of Arthritis and Radiculitis. Louis J. Gelber. Mississippi Valley Med. J. 71 226-33 (1949) Nov.

The results of the treatment of 150 cases of arthritis accompanied by radiculitis by deep x-ray therapy are presented. The amount of roentgens delivered was determined mainly by the x-ray findings as well as the clinical symptoms for each case. High voltage therapy with a filtration of 0.5 mm Cu and 1 mm Al in doses not exceeding 1,500 r in any one area was administered; treatments were 100 r three times weekly. Good results have been obtained for more than a three-year period following therapy in 65% of the cases.

1903 X-ray Therapy in Arthrosis Deformans. Martin Corsten. Med. Klin. (Munich) 44, 1127-9(1949) Sept. 2 (in German).

Three-hundred patients suffering from arthrosis deformans were subjected to deep x-ray therapy in 3 to 4 sittings; (a second series of sittings could be applied without danger one-half year after the first.) Technical radiation data are given as follows: the irradiation was delivered by a 155-kv machine with a filtration of 0.5 mm Cu and at a target distance of 30 cm; the dosage, about 500-560 r, was administered at the rate of 55 r/min. The cases were classified in three groups according to the extent of their illness. Only 7% of the treated cases did not show any improvement as far as pains and function of joints is concerned. Results in advanced cases were as favorable as in the lighter cases. The treatment was not specific and did not change deformation and destruction of the joint. This type of treatment is recommended especially for advanced cases, where other therapeutic methods fail to mitigate pain.

1904 X-ray Therapy of Hodgkin's Disease. A. Herve. Acta Clinica Belgica 3, 397-418(1948)(in French).

The results in 125 cases of Hodgkin's disease treated with x-rays, and a review of the literature are presented. The author's cases show a survival rate of 39.6 months; the 5-yr survival rate was 20.3% and the 10-yr survival rate 8.3%. It is concluded that new irradiation techniques will probably not improve the results, but association of radiotherapy with certain mitotic poisons like "nitrogen mustards" may.

1905 X-ray Treatment of Chronic Rheumatic Polyarthritis. P. Thurn. Strahlentherapie 79, 177-85(1949)(in German).

Twelve cases of chronic rheumatic polyarthritis were treated with x-ray radiations delivered by a 180-kv machine, with a filtration of 0.5 mm Cu, at a target distance of 40 cm and at the rate of 17 r/min. The total dosage given for the hands was 600 r in 4 weeks to 1,050 r in 6 weeks; in two cases the hands received 3 courses of treatment for a total of 3,050 r. In 3 cases the feet were treated with 500 to 750 r in 3 to 4 weeks; shoulder treatments were given twice, with

1,050 r and 1,500 r, within 7 weeks; hips were treated in 4 cases with 800 r in 7 weeks to 1,200 r in 6 weeks and in one case a second series was necessary, a total of 2,100 r being administered. Four cases of arthritis of the knee were given from 900 r in 6 weeks to 1,950 r in 8 weeks, and an additional 1,200 r in the latter case; in one case the elbow was irradiated with 700 r in 7 weeks. Only rarely and for a short duration was it possible to mitigate pain and in no case anything like healing could be achieved. 23 references.

1906 Behavior of Uranium at the Dropping Mercury Electrode in the Presence of Complexing Anions. II. Bicarbonate and Carbonate Media. W. F. Neuman. AECD-2769, nd, Decl. Dec. 22, 1949. 42p. (Proposed for publication in NNES, Div. VI, Vol. 1, Chap. 18, Sec. 3.)

It has been observed in a previous investigation on the ultrafiltration of uranium from blood sera, that the concentration of uranium in the filtrate is a direct function of the CO_2 content of the sera. Further experimental evidence has shown that uranium exists in blood predominantly as the bicarbonate complex. This report concerns the investigation of this complex, particularly its chemical behavior under physiological conditions. The investigation was carried out by polarographic means with a dropping mercury electrode. Theoretical considerations of the reaction mechanisms are presented. Diffusion studies of ionic and molecular species present in buffered solutions of uranyl acetate are presented in order to help determine the penetration of uranyl ion through membranes of the human body.

1907 The Isolation of Micro-Quantities of Uranium by Precipitation with Protein Prior to the Fluorometric Determination of Uranium—A detailed Study of the Factors Involved. Nathan Glover. AECU-667, nd. 57p. (Proposed for publication in NNES, Div. IV, Vol. 1, Chap. 19, Sec. 1.)

This report presents a detailed study of the conditions required for the quantitative separation of uranium by means of protein from substances which interfere with its fluorometric determination. This separation was prerequisite to the fluorometric determination of uranium and has been used in studies on the distribution and excretion of uranium in animals. The general procedure was as follows: the acid solution of ashed tissue and uranium was neutralized with alkali to pH 4.2-5.0, made 0.05M with acetate buffer, pH 5.0, 120 mg of albumin was then added, and the solution volume adjusted to 35 ml with distilled water. After the solution was heated, the coagulated protein-uranium mass was centrifuged, washed once with 0.05M acetate buffer, dissolved in concentrated nitric acid, and analyzed fluorophotometrically. Quantities of uranium as large as 2 to 5 mg and as small as 10 μg or less may be isolated quantitatively from 35 ml of pure solution under such conditions. Within this concentration range, the pH is not critical in the vicinity of the isoelectric point of the albumin (pH 4.4-5.5). Increase in the protein concentration, the pH, or decrease in the buffer concentration will raise this upper limit of uranium concentration that may be quantitatively isolated. The inverse relationship between buffer concentration and percentage of uranium isolated has been established and its importance demonstrated. All the readily available buffers react with uranium and thus compete with

the protein. Acetate buffer, being the weakest complexer, was chosen for the procedure. No difference was observed between sodium and ammonium acetate. Citrate has 10 or more times the complexing affinity for uranium as acetate at pH 4.6 or higher. Because more than 90% of the bound uranium can be removed with bicarbonate, it is concluded that the protein-uranium combination is dissociable even though the protein is coagulated. Quantitative isolation of uranium from solution was obtained with crystallized egg albumin, bovine serum albumin, Fraction V from bovine plasma, and commercial preparations of egg albumin powders. Quantitative isolation of uranium was achieved from solutions of ashed kidney and bone at ratios of 1:100 and 1:1000 of uranium:tissue ash. The bone studies using Ca^{45} showed that at pH 5.0 the isolated uranium was practically free of calcium salts. The quenching effects of ashed kidney and bone upon the fluorescence of uranium-sodium fluoride fusions were determined and found to be about 20% in the presence of 50 μg of tissue ash. 20 references. (auth)

1908 Repeated Intraperitoneal Injections of Uranyl Nitrate. Ann G. Dinse, T. B. Barnett, Harold C. Hodge, and Elliott A. Maynard. AECD-2770, nd, Decl. Dec. 22, 1949. 29p. (Proposed for publication in NNES, Div. VI, Vol. 1, Chap. 20, Sec. 1.)

Groups of male and female rats were injected daily for one month with the same volumes (10 cc/kg) of various concentrations of uranyl nitrate hexahydrate in aqueous solution. In the first experiment weanling female rats were treated as follows: (1) control group, no treatment, (2) control group, injected with distilled water daily, (3) dose of 0.08 mg/kg daily, (4) dose of 0.40 mg/kg daily, (5) dose of 2.0 mg/kg daily. In the second experiment weanling male rats were treated as follows: (1) single dose of 1.0 mg/kg, (2) dose of 0.17 mg/kg daily, (3) dose of 0.67 mg/kg daily, (4) dose of 1.0 mg/kg daily. None of the control rats and none of the rats receiving up to and including 0.40 mg/kg daily died. Of the remaining three groups, the mortalities were as follows: 0.67 mg/kg daily, 20%; 1.0 mg/kg daily, 60%; 2.0 mg/kg daily, 90%. During the one-month period of treatment of growth rates of the control rats, those receiving the single dose, and those receiving daily doses of 0.08 and 0.17 mg/kg, respectively, were all closely similar; specifically, the average body weights at the end of the month were within 10 grams of each other. Considerable growth depressions followed the daily injection of 0.40 to 2.0 mg/kg. At the time of autopsy, organ weights were recorded. In general, the rats had sacrificed body weight in order to maintain the vital organs. An exception was the liver which showed a loss in weight. When the daily doses are computed as cumulative doses the total amounts administered are found to be small; for example, a daily dose of 0.08 mg/kg gave a total dose of only 0.3 mg during the month, and the highest dose, 2.0 mg/kg, amounted to only 4.0 mg in the month. The anatomical diagnosis showed the following progressive increase in renal injury with dosage: 0.08 mg/kg, very slight changes; 0.17 mg/kg, slight changes; 0.40 mg/kg, mild to moderate injury; 0.67 mg/kg, moderate to moderately severe injury; 1.0 mg/kg, moderately severe injury. There were too few survivors to assess the relative damage following the administration of 2.0 mg/kg. These data provide the basis for indicating the relationship between percentages of uranyl nitrate mixed into the diets of rats and

ingested for one month and the daily doses given intraperitoneally. Using mortality as a criterion, 1% of uranyl nitrate hexahydrate in the diet is roughly equivalent to 0.2 to 0.3 mg/kg intraperitoneally. Using weight depression as a criterion, 1% in the diet is roughly equivalent to 0.33 to 0.39 mg/kg intraperitoneally. Using the pathological changes as a criterion, 0.5% in the diet is compared with 0.17 mg/kg and 2.0% in the diet is compared with 0.67 mg/kg; therefore, 1% in the diet is intermediate between 0.17 and 0.67 mg/kg intraperitoneally. (auth)

1909 Age Versus Toxicity. Elliott A. Maynard. AECD-2771, nd, Decl. Dec. 22, 1949. 24p. (Proposed for publication in NNES, Div. IV, Vol. 1, Chap. 20, Sec. 2.)

Groups of male and female rats were placed on diets containing 2% of uranyl nitrate hexahydrate for periods of 30 days. The rats varied in age from 17 days to 6 months. In most of the cases groups of 50 males and 50 females were studied. In a few instances, groups as small as 20 or less were used. The groups of 50 were made up of two groups of 25 each, so that it is possible to compare essentially duplicate experiments. The mortality in both male and female rats has an extraordinary dependence on the initial age. The 17-day-old rats were found to be highly susceptible; all of these rats died. Between 17 and 30 days of age there is a precipitate and linear decrease of mortality to values less than 20%. Thereafter, the susceptibility increases with age somewhat more rapidly for the male rats than for the female rats to a value of about 75% at age 6 months. The growth responses are grouped into three categories: (a) very young rats fail to grow; (b) weanling rats, 21 to 30 days, exhibited a transient decrease in growth rate followed by growth curves parallel to those of the control groups; (c) young adult rats precipitously lost weight for about 2 weeks and thereafter regained weight with nearly the same rapidity. The differences in susceptibility to uranium poisoning as a function of age may depend on such factors as differences in skeletal development, differences in body weights, or differences in food intake.

Groups of male and female rats were given intraperitoneal injections of an aqueous solution of uranyl nitrate hexahydrate (50 mg/cc). The doses were chosen to give a high mortality in adult rats; male rats received 128 mg/kg, female rats 200 mg/kg. The 24 and 48-hr mortalities were recorded. The rats selected varied in age from 21 days to 6 months. For the most part, groups of 50 males and 50 females were studied. The youngest rats were more susceptible than those 1 to 3 months of age. The older rats were more susceptible than the weanlings. Although the variation in age in the 24-hr mortality is qualitatively similar to the variation of mortality with age in the feeding experiment described previously, the mechanisms involved are probably different. The reason for the resistance of the 1-month-old rat is not known. (auth)

1910 Effect of a Single Dose of Uranyl Nitrate. W. L. Downs, Elliott A. Maynard, and Harold C. Hodge. AECD-2772, nd, Decl. Dec. 22, 1949. 21p. (Proposed for publication in NNES, Div. VI, Vol. 1, Chap. 20, Sec. 3.)

Fifty male and 50 female rats were given access to a diet containing 2% uranyl nitrate hexahydrate for a single 24-hour period and thereafter maintained for 10 months on the stock ration. Equal groups of control rats were observed during the same period. The rats were kept in pairs, 1 male and 1 female in each cage. The male rats were removed from the cage near the end of the gestation period. The litters were removed at birth and the rats remated. There was no interference in growth associated with the single dose of uranyl nitrate hexahydrate. A single 24-hour feeding of uranyl nitrate did not reduce the number of females bearing litters. The experimental female rats had a small reduction in the number of litters but a larger reduction in the total number of pups. It seems to be reasonable to conclude that, under the circumstances of this experiment, uranium administration adversely affected the reproductive functions in the absence of a severe derangement of nutrition. (auth)

BIOLOGY AND MEDICINE

1911 One-year Feeding Test. Serial Study of Uranyl Nitrate. Elliott A. Maynard, T. B. Barnett, W. L. Downs, W. F. Neuman, and Harold Hodge. AECD-2773, nd, Decl. Dec. 22, 1949. 55p. (Proposed for publication in NNES, Div. VI, Vol. 1, Chap. 20. Sec. 4.)

Groups of male and female rats have been maintained on diets containing 0 (a control group), 0.1, 0.5, and 2.0% uranyl nitrate hexahydrate, respectively, for various periods up to one year. In a large-scale, serial sacrifice study, rats were examined at daily intervals for the first 5 days, at weekly intervals for the first month, at intervals of 2 weeks for the first 6 months, and at the 30th, 38th, and 52nd weeks. The growth was notably depressed in rats maintained on a diet containing 2% uranyl nitrate hexahydrate. The addition of 0.1% produced a negligible, if any, effect on growth. The growth rates of rats on the 0.5% diets consistently averaged slightly below those for the control rats. Mortality data are available on 125 male and female rats, respectively, at each of the dietary levels during the first week. Data are available on 100 of each sex during the first 14 weeks, on 75 of each sex during the first 36 weeks, and 50 of each sex during the balance of the year. An abnormally-high mortality was observed in the rats on the 2% diet; in contrast, the rats on the 0.5 and 0.1% diets exhibited the same order of mortality as did the control rats. The uranium content of the kidneys increased with increasing percentages of uranyl nitrate in the diet. The uranium content of the femurs of the rats on the 0.5% diet ultimately reached values of approximately 20 μg U/g; on the 2% diet the values became as great as 200 μg U/g. Based on a number of assumptions, it has been calculated that the rat absorbs about 0.1% of the uranium from the diet. From hematological observations it was concluded that long-continued administration of uranyl nitrate hexahydrate at a dietary level of 2% was accompanied by a low-grade anemia and a tendency toward a low-grade leukocytosis. Extensive histological examinations failed to reveal any renal abnormalities in rats maintained on the diet containing 0.1% of uranyl nitrate hexahydrate. In rats fed the 0.5% diet, mild tubular necrosis occurred during the first week, followed by epithelial regeneration, so that only slight traces of injury were present at the end of the experiment. The kidneys of rats maintained on the 2% diets showed moderately severe tubular necrosis initially, followed by regeneration. In these rats, however, pathological changes developed progressively, different from the initial injury and characterized by tubular atrophy, increase in stroma, and narrowing of the cortex. The only other abnormalities appearing regularly were found in the testes of the male rats on the 2% diet. The origin of these changes is obscure. (auth)

BIOLOGY AND MEDICINE

1912 Two-year Feeding Test. Uranium Dioxide. Elliott A. Maynard, W. L. Downs, and Harold C. Hodge. AECD-2774, nd, Decl. Dec. 22, 1949. 21p. (Proposed for publication in NNES, Div. VI, Vol. 1, Chap. 20, Sec. 5, Part 1.)

Groups of 50 male and 50 female rats were fed diets containing 0, 0.5, 2.0, and 20% UO_2 for a period of two years. There was no evidence of a depression of body weight in any of the groups. The mortality for each group compared favorably with the mortalities observed in control rats. There was no indication of a shortening of life span. Results of hematological observations were uniformly negative. Uranium analyses for sugar and for protein were essentially negative. Pathological examinations showed none of the changes characteristic of uranium poisoning. The usual scattering of incidental pathological changes was noted. The uranium content of the kidneys did not increase as the percentage of UO_2 increased in the diets. The uranium content of the femurs increased slightly with increase in UO_2 content of the diets. (auth)

1913 Two-year Feeding Test. Uranium Tetrafluoride. Elliott A. Maynard, W. L. Downs, and Harold C. Hodge. AECD-2775, nd, Decl. Dec. 22, 1949. 12p. (Proposed for publication in NNES, Div. VI, Vol. 1, Chap. 20, Sec. 5, Part 2.)

Groups of 50 male and female rats were fed diets containing 0, 0.5, 2.0, and 20% of UF_4 for a period of two years. Only the groups fed a 20% UF_4 diet exhibited a growth depression, but even in these rats the effect was not large. There was no indication that UF_4 even up to 20% of the diets decreased the life span. In the hematological observations there was little or no indication of any change ascribable to the UF_4. Urine analyses for sugar and protein were uniformly negative. Only in the kidneys were any changes found on histological examination that could be attributed to the administration of uranium; and in this organ mild tubular degeneration with typical and atypical regeneration were described only in the rats fed the 20% diets. The usual nonspecific pathological changes were also found. The uranium content of the kidneys and femurs increased somewhat with increasing the percentage of UF_4 in the diet. (auth)

1914 Two-year Feeding Test. Uranyl Fluoride. Elliott A. Maynard, W. L. Downs, and Harold C. Hodge. AECD-2776, nd, Decl. Dec. 22, 1949. 35p. (Proposed for publication in NNES, Div. VI, Vol. 1, Chap. 20, Sec. 5, Part 3.)

Groups of male rats, for the most part 25 each, were fed diets containing 0, 0.01, 0.05, 0.10, 0.15, 0.25, and 0.50% of uranyl fluoride for two years. Groups of female rats, 15 to 25 per group, were fed diets containing 0, 0.01, 0.05, 0.25, and 0.50% uranyl fluoride for a period of two years. In the male rats and in the female rats the 0.05% diet did not depress body weight. In the male rats 0.1% uranyl fluoride was the lowest dietary percentage producing weight depression. Diets containing 0.15% consistently depressed the body weights of male rats, and diets containing 0.25% produced depressed body weights in both male and female rats. The addition of 0.25% of uranyl fluoride shortened the life span of the male rat but not that of the female. The addition of 0.05% was without effect on the life span. Hematological observations showed a trend for red blood cell counts and hemoglobin

BIOLOGY AND MEDICINE

values to be depressed in male rats with increasing percentages of uranyl fluoride. A tendency toward higher white blood cell counts in the rats on the higher doses of uranyl fluoride was also found. Urine analyses for sugar and protein were surprisingly free from evidence of a positive response to the administration of such amounts of uranium. Uranium content of the kidneys and of the femurs increased with increasing percentages of uranyl fluoride in the diets. The fluoride content of bones and teeth increased with increasing concentration of uranyl fluoride in the diet. Based on the amounts of uranium and amounts of fluoride found in the bone, it is probable that about 5000 times as much fluoride is absorbed as uranium. As a result of histological examinations, the addition of 0.10% or lower percentages of uranyl fluoride was described as producing no evidence of injury. Adding 0.15% produced minimal and inconsistent renal tubular changes; this level may be considered as the lowest producing just detectable change. Testicular atrophy was also described. There is no evidence that the frequency of spontaneous disease was affected by adding uranyl fluoride to the diets. (auth)

1915 Two-Year Feeding Test. Uranyl Nitrate Hexahydrate. Elliott A. Maynard, W. L. Downs, and Harold C. Hodge. AECD-2777, nd, Decl. Dec. 22, 1949. 30p. (Proposed for publication in NNES, Div. VI, Vol. 1, Chap. 20, Sec. 5, Part 4.)

Groups of 15 to 25 male and female rats were fed diets containing 0, 0.01, 0.05, 0.1, 0.5, 1.0, and 2.0% uranyl nitrate hexahydrate for a period of two years. For the male rats, diets containing up to 0.05% uranyl nitrate hexahydrate produced no detectable depression in weight; female rats tolerated a diet containing 0.10% without effect on growth. The lowest percentage in the diet associated with detectable growth depression was 0.1 for the male rats, and 0.5 for the female rats. Even 2% of uranyl nitrate hexahydrate did not lessen the life span over a two-year period. The hematological observations were essentially negative for the male rats; but revealed a tendency for an anemia and a low-grade increase in white blood cell counts for the female rats fed the 1.0% and the 2.0% diets. Urine analyses for sugar and protein gave no evidence of a chronic or continuing uranium effect. On the contrary, there was an apparent trend toward a lessened positive response with increasing amounts of uranyl nitrate in the second year. Uranium contents of the kidneys and femurs of the rats increased with increasing uranium in the diet. On the basis of detailed histopathological examinations, the kidney has been found to be the only organ exhibiting significant changes. There was a clear-cut dependence of the degree of injury on the dosage. No histological change identified as uranium poisoning was found in the kidneys of rats fed the 0.01, 0.05, and 0.1% diets. The kidneys of the rats fed the 0.5% diets exhibited subtle, borderline changes; this percentage may be identified as a + or − zone of minimal response. In the rats fed the 1 and 2% diets the changes were typical and consistent. A number of male rats showed degenerative changes in the testes. The common pathological findings were seen; there was no evidence of a relation between the frequency of spontaneous disease and the feeding of uranyl nitrate hexahydrate in the diet. Evidence of tolerance to acute uranium poisoning was found in rats that had been ingesting diets containing uranyl nitrate for two years. (auth)

BIOLOGY AND MEDICINE

1916 One-Year Feeding Experiments on Dogs. Elliott A. Maynard and Harold C. Hodge. AECD-2778, nd, Decl. Dec. 22, 1949. 38p. (Proposed for publication in NNES, Div. VI, Vol. 1, Chap. 20, Sec. 6.)

A total of 30 dogs were fed various daily doses of five uranium compounds, i.e., UO_2, UF_4, $UO_2(NO_3)_2.6H_2O$, UCl_4, and UO_2F_2 at levels that were tolerated for a period of one year. Sixteen control dogs were also studied. The daily dosage levels ranged from 0.0002 g/kg body weight of the soluble UO_2F_2 to 10 g/kg body weight of the insoluble UO_2. At the end of the one-year feeding period the only dogs in which an adverse effect on growth was noted were those which received uranyl nitrate at a daily dosage of 0.2 g/kg body weight. A questionable effect was noted when UF_4 was fed daily at a level of 5 g/kg. When blood NPN (nonprotein nitrogen) and urea nitrogen values were used as criteria of toxicity it was apparent that in most of the dogs studied there was not produced a marked acute uranium poisoning. Some scattered abnormal urinary protein and sugar values were found. This was particularly noticeable in the dogs fed UCl_4 at a daily level of 0.05 g/kg body weight. Most of the recorded values did not deviate greatly from normal values. Histological studies disclosed that renal cortical tubular changes are the principal pathological effects of feeding uranium compounds to dogs. No marked abnormalities occurred in the hematological picture when observations were made on red cell counts, white cell counts, hemoglobin, and differential white cell counts at various intervals during the one-year feeding period. A limited number of uranium analyses were made of tissues from dogs fed uranyl nitrate hexahydrate and UCl_4. The highest liver value reported was 2 μg/g for a dog fed 0.05 g/kg. Kidney values mostly ranged below 1 μg/g. Bone values ranged from 1 to 5 μg/g. When blood fluoride determinations were made on the dogs which received daily doses of UF_4 for a period of 1 year it was evident that the dependence of the blood fluoride level on dietary intake of fluorine is essentially a linear function. Analyses of bone and tooth samples from these same dogs also demonstrated that the dependence of bone and tooth content of fluorine on the amount of fluorine ingested is nearly linear. (auth)

1917 Introduction [Chronic One-Year-Uranium Compounds Inhalation Studies]. H. E. Stokinger. AECD-2779, nd, Decl. Dec. 22, 1949. 9p. (Proposed for publication in NNES, Div. VI, Chap. 21, Sec. A, Part 1.)

In this chapter introduction, the previous 30-day exposure studies are briefly reviewed and the purposes and method of attack for one and two-year chronic exposure studies are discussed.

1918 Special Methods and Procedures. Establishment of Dusty Atmospheres. [Chronic One-Year Uranium Compounds Inhalation Studies]. H. E. Stokinger. AECD-2780, nd, Decl. Dec. 22, 1949. 6p. (Proposed for publication in NNES, Div. VI, Chap. 21, Sec. A, Part 2.1.)

The methods and equipment used in determining chamber-dust concentration, chamber-dust distribution, and particle size during the one-year studies are discussed briefly.

1919 Discussion and Interpretations. [Chronic One-year Uranium Compounds Inhalation Studies]. H. E. Stokinger. AECU-668, nd, 39p. (Proposed for publication in NNES, Div. VI, Chap. 21, Sec. A. Part 5.)

The data from 13 one-year inhalation studies and a single two-year pilot study have been evaluated and the following goals are discussed: (1) the characteristics of animal response to one and to two years' exposure to uranium dusts; (2) the extent of the deposition, retention, and elimination of uranium by the animal body under known conditions of exposure for one and for two years; (3) the safe limits of exposure and borderline levels for one year for three typical soluble uranium compounds, $UO_2(NO_3)_2.6H_2O$, UCl_4, and UF_6, and for two representative insoluble dusts, UF_4, and UO_2.

1920 Summary and Conclusions [Chronic One-year Uranium Compounds Inhalation Studies]. H. E. Stokinger. AECU-669, nd. 71p. (Proposed for publication in NNES, Div. VI, Chap. 21, Sec. A, Part 6.)

An extensive study of the toxicologic effects appearing in animals exposed by inhalation daily for one year to 5 uranium dusts has been made and the results evaluated. 3100 animals comprising chiefly dogs and rats and supplemented with smaller numbers of rabbits and guinea pigs were used for the test of the effects at 12 concentration levels involving the 5 dusts. The toxic effects sought were those of minimal or no injury for one year from which recommendations would be formulated as to what dust concentrations might be proposed as the "maximal allowable concentrations" for each of these materials. At the same time, evidence could be cited as to the probable "margin of safety" between the MAC and the lowest dust concentration which will consistently evoke toxic responses in even a resistant species. Accordingly, exposure levels for the 3 soluble toxic uranium dusts, uranyl nitrate hexahydrate, uranium hexafluoride, and uranium chloride, included concentrations as low as 0.04 to 0.2 mg U/m^3; for the insoluble, less toxic dusts, uranium tetrafluoride and uranium dioxide, levels were from 0.5 to 10 mg U/m^3, selected on the basis of considerable past experience with uranium dust exposures of a short-term, acute nature. A control study in which no toxic dusts were inhaled was performed for one year concomittantly with the uranium exposures on similar groups of animals and on which the same tests and criteria were employed as were used in the one-year dust inhalation studies. From a comparison of the responses among the uranium-exposed animals with those of the control animals, several important conclusions have been reached. Incidental to the main conclusions was the finding that a conditioning period of about 4 months was required to insure the inclusion of all individual animal data within a reasonable variation from the mean and thus establish a satisfactory base line for comparison with responses from exposure. (auth)

1921 The Effects of Exposure of Rabbits and Rats to Inhalation of Uranium Dioxide Dust at 22 Mg/M^3 Concentration and 0.5 μ Particle Size. Herbert B. Wilson and George Sylvester. AECD-2781, nd, Decl. Dec. 22, 1949. 15p. (Proposed for publication in NNES Div. VI, Vol. I, Chap. 21, Sec. D.)

Rats and rabbits were exposed to UO_2 of mass median particle size of approximately 0.5 μ and at a concentration of 22 mg/m^3 for a total of 140 hr during a 28-day period. No evidence of toxicity was found in the rat. Slight toxic effects were noted in the rabbit. Five of 16 showed very mild renal

injury on micropathological examination. Five rabbits revealed a slight tendency to proteinuria; whereas possible significant elevation of amino acid N-creatinine ratios was observed in 2 cases. Weight response was normal for both species. Deposits of uranium in the tissues of rabbits subjected to the full 140 hr of exposure were found to average 8, 1.0, and 1.8 μg/g of tissue for lung, kidney, and femur respectively; 30, 2.0, and 1.2 were the corresponding values for the rats. (auth)

1922 The Relation Between Mean Particle-Size and the Toxicity of Particulate Uranium Dioxide. H. E. Stokinger. AECD-2782, nd, Decl. Dec. 22, 1949. 81p. (Proposed for publication in NNES; Div. VI, Vol. 1, Chap. 21, Sec. F.)

Particulate uranium dioxide was separated into seven fractions differing in particle size over the range 11 to 0.35 μ. Equal weights of these fractions were administered to white rats by intratracheal injection, and the magnitude of the ensuing response was estimated by measurement (a) of weight change, (b) of accumulation of nonprotein nitrogen in the blood, and (c) of the ability of the kidney to excrete phenolsulphonphthalein. The quantity of uranium in the lungs, kidneys, and femurs was determined analytically. The following conclusions are reported: (1) administration of uranium dioxide in the lungs of rats leads to a typical response originating primarily in the damage which is produced in the kidney; (2) the intensity of this response is a function of the particle-size of the uranium dioxide such that the greater response is associated with the smaller particles and the lesser response with the larger particles; (3) particles smaller than 1 μ are relatively more active in causing damage than are particles greater than 1 μ, and there is no indication that a limit had been reached at 0.35 μ which was the smallest size tested; (4) the intensity of the reaction in the kidney is proportional to the quantity of uranium present in the kidney; (5) the variation of toxicity which is associated with variation in particle size reflects a corresponding variation in the quantity of uranium which gains access to the systemic circulation; (6) the quantity of uranium entering the systemic circulation cannot be measured by following the changes in the uranium content of the lung; (7) appreciable fractions of an administered dose of uranium dioxide are removed by some route which does not involve the circulating blood; (8) the amount of uranium removed by this route is a function of particle-size such that the efficiency is greater for larger particles and lesser for smaller particles; (9) the rate of solution of uranium dioxide in the lung could not be shown to be proportional to the amount of surface available, since large increases in surface led to relatively small increases in the amount of systemic uranium recovered; (10) a concept is offered for the distinction between deposition as an entity differing from retention in the lung. 48 references. (auth)

1923 Calcium Exchange as the Mechanism for Adsorption of the Radioactive Isotope by Bone. W. F. Neuman et al. AECU-671, nd. 27p. (Proposed for publication in NNES, Div. VI, Vol. 1, Chap. 24, Sec. 9.)

In vitro experiments in which powdered bone ash was exposed to solutions of calcium chloride containing Ca^{45} have shown that bone exchanges calcium with the solution. The Ca^{45} concentration rises rapidly until it reaches a "quasi equilibrium." The exchangeable bone calcium represents at the most less than 20% of the total bone calcium; this fraction is of the same order of magnitude as that previously reported for the exchangeable bone phosphate. This reaction is reversible to the same "quasi equilibrium" point. 14 references. (auth)

1924 The Mechanism of the Action of Uranium on Cells. A. Rothstein, R. C. Meier, L. Hurwitz, H. L. Berke, and C. Larrabee. AECD-2783, nd, Decl. Dec. 22, 1949. 51p. (Proposed for publication in NNES, Div. VI, Vol. 1, Chap. 25, Sec. 3.)

Uranium in low concentrations inhibits the anaerobic or aerobic metabolism of glucose and fructose by yeast and the fermentation of galactose by "adapted" cells. Concentrations of uranium which inhibit sugar metabolism, however, have little or no effect on the aerobic metabolism of lactate, acetate, pyruvate, or alcohol, but much higher concentrations of uranium partially inhibit metabolism of acetate or lactate. Uranium has little effect on endogenous metabolism of reserve stores, on the degradation or synthesis of glycogen, or on fermentation of glycogen induced by dinitrophenol. The kinetics of metabolism in the presence and absence of uranium can be fitted by the Michaelis-Menton equation, or simple modifications. A difference in kinetics of anaerobic and aerobic metabolism is paralleled by a difference in inhibition curves. More uranium-binding, cell-surface loci are involved in aerobic than in anaerobic metabolism. Elevation of the temperature reverses the uranium inhibition. This effect is due not to dissociation of the uranium cell-surface complex, but is associated with a higher energy of activation for the uranium inhibited reaction, as compared to the normal rate-limiting process. The same uranium-binding loci are involved in the metabolism of glucose and fructose, but different loci are involved in galactose metabolism in "adapted" cells. The dissociation constant for the uranium cell-surface complex is best matched by the constant for the uranium-polyphosphate complex. A hypothesis for the mechanism of action of uranium is presented. Sugars do not penetrate the cell by a simple diffusion process, but are actively transported. The transport mechanism involves the phosphorylation of glucose by hexokinase and adenosine triphosphate on the surface of the cell. The resynthesis of adenosine triphosphate must also occur on the surface of the cell. Uranium inhibits sugar transport by complexing with polyphosphate group of adenosine triphosphate, thereby preventing transphosphorylation. This mechanism is consistent not only with the data on yeast, but with the known facts concerning the action of uranium on the kidney tubule. 59 references. (auth)

1925 Suggested Maximum Allowable Concentration of Insoluble Uranium Compounds in Air. H. C. Hodge, H. E. Stokinger, W. F. Neuman, W. F. Bale, and A. E. Brandt. AECD-2784, nd, Decl. Dec. 22, 1949. 115p. (Proposed for publication in NNES, Div. VI, Vol. 1, Chap. 26, Sec. 1.)

At the end of a year's exposure to atmospheres containing UO_2 at concentrations averaging about 10 and 1 mg as U/m^3, respectively, the uranium content of lung tissue and of pulmonary lymph nodes was as follows:

BIOLOGY AND MEDICINE

Air Content (mg U/m³)	Uranium Content: Dog Lung (μg/g)	Dog P.L.N. (μg/g)	Rat Lung (μg/g)
10	950	2500	300-600
1	116	198	50-100

By a process of interpolation, it is predicted that if conditions comparable to those in the experiments were maintained, except that the dust concentrations were lowered to 500 or 50 μg U/m³, the uranium content of lung tissue and of pulmonary lymph nodes would be as follows:

Assumed Air Content (μg U/m³)	Predicted Average Uranium Content in Lung or Pulmonary Lymph Nodes (μg/g)
500	50 to 120
50	6 to 12

The uranium tolerance for tissue (considering uranium as an internal α radiator) is calculated to be of the order of 25 μg U/g fresh tissue. Based on the predicted uranium deposition in lung tissue and in pulmonary lymph nodes and on the calculated uranium tolerance for α radiation, the maximum allowable concentration is tentatively proposed as 100 μg/m³. This concentration has a probable safety factor of 2 to 5 fold. From the few available analyses of dogs and rats exposed for one year to 10 mg/m³ as UO_2 and for an additional year to 2 mg/m³ as uranium nitrate, the biological half-life of UO_2 dust particles in the lung is calculated to be of the order of 2 to 4 months. Only short-term (30 day) exposures to UO_2 dusts of controlled particle size are available. These show a marked correlation between decreasing particle size in the range of 2 to 0.5 microns and increasing lung retention of uranium. Large particles (2μ) inhaled at 80 mg/m³ gave rise to an average lung content of about 150 μg U/g, whereas small particles (0.5μ) at the same concentration produced an average lung content of over 1200 μg U/g. Similar studies to those on UO_2 were made on animals exposed to UF_4 at 3 and 0.5 mg/m³, respectively. No such high uranium values in lung and in pulmonary lymph nodes were found for UF_4, although this tissue showed unquestionably larger uranium contents than followed an exposure to uranium nitrate at 2 mg/m³. The insoluble UO_2 and, to a much lesser degree, UF_4 tend to accumulate in the lung when animals breathe such dusty atmospheres. A small amount of uranium gets into the body fluids and is deposited in the skeleton or is excreted via the kidneys and the urine. The bone and kidney uranium contents are entirely comparable in magnitude following dust exposures to 10 or 1 mg U/m³ as UO_2, to 3 or 0.5 mg U/M³ as UF_4, or to 2 mg U/m³ as uranium nitrate. Studies of the chemical toxicity of UO_2, UF_4, high-grade ore, and U_3O_8 have been summarized and tabulated. Eight 30-day studies are reported for various air concentrations of UO_2, 5 such studies on UF_4, 3 on high-grade ore, 1 on U_3O_8, and 5 on control groups. Two year-long experiments have been conducted on UO_2 dusts and 2 on UF_4 dusts; a single chronic control group has been examined in exactly comparable ways. From the standpoint of chemical toxicity, the suggested maximum allowable concentration range of 200 to 250 μg/m³ in each case allows a reasonable margin of safety. (auth)

BIOLOGY AND MEDICINE

1926 Suggested Maximum Allowable Concentration of Soluble Uranium Compounds in Air. H. C. Hodge, H. E. Stokinger, and W. F. Neuman. AECD-2785, nd, Decl. Dec. 22, 1949. 107p. (Proposed for publication in NNES, Div. VI, Vol. 1, Chap. 26, Sec. 2.)

At the end of a year's exposure to soluble uranium compounds suspended as a dust in the atmosphere, the tissues of dogs, rats, rabbits, and guinea pigs contained on the average the amounts of uranium shown in the accompanying table.

Approximate Air Concentration (μg/m³)	Lung (μg/g)	Kidney (μg/g)	Bone Ash (μg/g)
2000	1.3	2.3	5.9
250 - 150	0.6	0.8	1.8
50 - 40	0.4	0.4	0.4

On the average, the lung contains the least, the kidney intermediate amounts, and the bone the highest amounts of uranium. With increasing air concentration, there is a tendency for an increase in the tissue content of uranium. From analyses of the uranium content made during the year, it is evident that with increasing exposure time there is an increase in bone deposition of uranium. This is not a large increase at any concentration, but it is clearly distinguishable in the tests at the higher dust levels. Even at an air concentration of 2000 μg U/m³, the predicted maximal bone uranium content is only 17 μg U/g. If the figure of 25 μg U/g of tissue is accepted as the uranium tolerance for tissue (considering uranium as an internal α emitter), it is evident that the amount deposited in bone following the inhalation of atmospheres containing the maximum allowable concentration will never constitute a radiological hazard. Based on the rate of deposition of uranium in the rat femur when rats are exposed to an atmosphere containing 2000 μg U/m³ as uranyl nitrate hexahydrate dust, the predicted "biological half life" of uranium in rat bone is of the order of 10 months. The known typical uranium injury to the kidney is an extremely sensitive and reliable indicator of toxic effect; the amount of a soluble uranium compound in the air which fails to produce any kidney injury is taken as a physiologically safe concentration. The air concentration of 50 μg U/m³ of soluble uranium dusts is recommended as a tentative maximum allowable concentration. Studies of the chemical toxicity of UF_6, UO_2F_2, $UO_2(NO_3)_2 \cdot 6H_2O$, and UCl_4 have been summarized and tabulated. Three 30-day studies are available on UF_6, four on UO_2F_2, four on uranyl nitrate hexahydrate, and five on UCl_4. Two 1-year studies are available on UF_6, four on uranyl nitrate hexahydrate, and two on UCl_4. One 2-year study is summarized in which the exposures during the first year were to several soluble and insoluble uranium dusts, and the exposure during the second year was to uranyl nitrate hexahydrate dust. From the standpoint of the toxic effects observed in all these studies, the maximum allowable concentration recommended, viz., 50 μg U/m³, appears to be a reasonable tentative figure. (auth)

1927 Urinary Uranium as a Measure of Exposure Hazards. W. F. Neuman. AECD-2786, nd, Decl. Dec. 22, 1949. 28p. (Proposed for publication in NNES, Div. VI, Vol. 1, Chap. 26, Sec. 3.)

The purpose of this report is to furnish an interim guide to industrial hygienists and plant management and to serve as a preliminary basis for the actual setting up of working stand-

ards by an authorized committee. The "recommended values" are based almost entirely on animal experimentation and can in no sense be regarded as final. The general metabolism of uranyl ion is reviewed briefly. Factors influencing the urinary excretion of uranium are discussed in detail. Based on known facts, the maximum concentration of urinary uranium which may be considered safe is calculated. Collection of urine specimens, storage and shipment of samples, and methods of analyses are also discussed. Finally, a suggested program of future research is presented which would aid in obtaining a more accurate evaluation of urinary uranium values. 42 references.

1928 The Effects of Uranium on Plants. Ann Goodenough Dinse. AECD-2787, nd, Decl. Dec. 22, 1949. 29p. (Proposed for publication in NNES, Div. VI, Vol. 1, Chap. 27, Sec. 1.)

In this literature review and bibliography all references are included to the effects of uranium on plants, found in Chemical Abstracts through March 10, 1949, Experiment Station Record through its last year of publication—1946, Biological Abstracts through 1948, and Bibliography of the Minor Elements through 1948. Low concentrations of the uranium salts are beneficial to plant and bacterial growth, but concentrations above a certain low level are growth retarding and even toxic. Seed germination is stimulated in the higher plants and nitrogen fixation is increased in bacteria, by a low uranium concentration. Uranium is a natural constituent of most soils, usually in amounts far greater than the needs of the plant. Plants may take uranium from the soil or nutrient solution; it occurs in greater amounts in roots than in stems and leaves. The effects of uranium are mainly attributed to its chemical properties, rather than to its radioactivity. 75 references.

1929 Special Materials. Inhalation Toxicity Studies of Boron Halides and Certain Fluorinated Hydrocarbons. Short-Term Feeding Study with Cobalt Fluoride in Rats. Determination of Boron Halides in Air. H. E. Stokinger. AECD-2788, nd, Decl. Feb. 14, 1949. 80p. (Proposed for publication in NNES, Div. VI, Vol. 1, Chap. 28.)

Part I. Toxicological studies on exposure hazards likely to be encountered in the industrial use of boron compounds and highly halogenated hydrocarbons are summarized. These studies were conducted with the following three aims in mind: (1) to provide preliminary toxicological data within 24 to 48 hr on materials suspected of being hazardous; (2) to evaluate the biochemical, histologic, and hematologic effects of repeated daily exposures for periods of 30 days; (3) to test and recommend suitable respiratory protective devices. Part II. Young, albino male rats were placed at weanling on diets containing 0 (control group), 0.01, 0.05, 0.1, 0.5, 2.0 and 20.0% of cobalt fluoride, respectively, with the following results. Amounts of cobalt fluoride up to 0.01% may be added to the diets without diminishing growth. Amounts of 0.05% or greater produced a loss of growth. Mortalities of 100% were promptly reached when diets containing 0.5% or greater were provided. A mortality of about 50% was observed in rats given the 0.1% diet. Only normal hematologic observations were made. Small spleens were found. Kidney weights were increased. Histologic studies revealed no specific toxic changes in the

BIOLOGY AND MEDICINE

tissues. Part III. The need for a rapid, semiquantitative method arose from the desirability of having a simple means of determining the approximate concentration of boron fluoride, boron chloride, and boron fluoride dimethyl ether in industrial and in experimental atmospheres. The method described here may be recommended as being simple and more rapid than other methods previously developed and consists merely of drawing a measured quantity of air containing boron halides through a filter paper impregnated with turmeric solution and then comparing the resultant color with a standard. Important factors considered are: (1) the relation between color developed and the number of strokes (or quantity of air sampled) at various fixed concentrations; (2) the relation between concentration and quantity of air for a fixed color; (3) the stability of the developed color; (4) the influence of the concentration of turmeric in the test paper; (5) the variation of the color as read by various observers; (6) the influence of other ions and gases on the test; (7) a confirmatory test; (8) the statistical analysis of results; and (9) the practical applications of the test.

1930 Summary [of NNES, Div. VI, Vol. 1, Chaps. 19-28]. H. C. Hodge. AECD-2789, nd, Decl. Dec. 22, 1949. 163p.

This report summarizes the chapters on chemistry, biochemical methods, oral toxicity, inhalation toxicity, insufflation studies, metabolic studies, bone deposition, enzyme studies, maximum allowable concentration, and effects of uranium on plants for the proposed portion of the NNES volume listed above.

1931 Metabolic and Cardio-Respiratory Studies on Patients with Beryllium Granulomatosis. Christine Waterhouse, E. Henry Keutmann, Joe W. Howland, and Robert A. Bruce. UR-101, Nov. 18, 1949. 30p.

Nitrogen balance studies carried out on six patients with chronic beryllium granulomatosis, have shown with one exception a consistently poor nitrogen storage on varying dietary intakes, under the influence of testosterone, as well as following intravenous albumin administration. Fecal excretion of nitrogen was uniformly high, probably as a result of inadequate absorption. An abnormally high fat or mineral excretion was not observed. A possible explanation of the faulty nitrogen storage or conversion may be related to a quantitative reduction in the ability of tissue cells to convert or alter ingested nitrogenous building materials into body protein. Existing evidence suggests that this alteration is not related to existing anoxia or to a caloric deficit. Continuous oxygen therapy in these patients produced changes simulating oxygen toxicity, the resultant over-all benefit being small. A disturbance in calcium balance was present in 3 instances in which calcium phosphorus balances were studied. This was manifest in a high urinary calcium excretion, the calcium balance being consistently negative in only a single case. (auth)

1932 Brain Metabolism in Vivo. I. The Distribution of Lesions Caused by Cyanide Poisoning, Insulin Hypoglycemia, Asphyxia in Nitrogen, and Fluoroacetate Poisoning in Rats. Samuel P. Hicks. Arch. Path. 49, 111-37(1950) Feb.

The distribution of destructive lesions of the brain and other organs of rats caused by insulin hypoglycemia, cyanide-

and fluoroacetate poisoning and by asphyxia was studied with a view to determining the mechanisms involved in the production of selective lesions. Cyanide poisoning, insulin hypoglycemia, and asphyxia damaged especially the brain but did not produce identical patterns of lesions; fluoroacetate poisoning was particularly destructive to the heart and the testes but caused little or no injury to the brain. Asphyxia and insulin hypoglycemia produced mild damage in the heart, but cyanide, in contrast to the other agents, tended to be selectively destructive to white matter in the brain. Fluoroacetate, which is believed to inhibit one phase of pyruvate catabolism, was especially deleterious to heart muscle, which is dependent not only on glucose (the prime substrate of the brain) but also on pyruvate. These concepts are considered tentative at present. (auth)

1933 The Chicago Society of Internal Medicine. Regular Meeting, November 28, 1949. Proc. Inst. Med. Chicago 18, 41-5(1950) Feb. 15.

Among the papers presented were the following: Beryllium Poisoning, Robert J. Hasterlik; The Use of Radioactive Isotopes in Neurological Diagnosis, John Martin. In the first paper the history of production of beryllium is briefly traced, and the groups of workers among whom the symptoms of the disease are most prevalent are described. Methods of diagnosis are presented and details for the prevention of the beryllium poisoning are discussed, along with the case history of a scientist dying of the malady. In the second paper, it is indicated that the pre- and post-operative localization of intracranial and intraspinal tumors through radioactive tracer techniques is being successfully carried out. The data on 75 patients studied with these techniques indicates the isotopes are of real practical value in diagnosis; the isotopes can be used to indicate the completeness of tumor removal at surgery.

1934 Delayed Damages of Thorotrast Judged by the Oldest Known Case of Injury. Rudolf Birkner. Strahlentherapie 78, 587-608(1949) (in German).

In the case of a middle-aged woman a tumor of the liver has developed within 15 years after the intravenous injection of 70 cc of thorotrast for x-ray diagnostic purposes. The clinical history is given, x-ray photograms reproduced, and the histology of the non-malignant tumor is described. Lasting injury to the RES (reticular-endothelial system) has been established as well as the existence of a panmyelopathy; the liver shows severe degenerative changes. In the thorotrast-tumor, a massive accumulation of thorotrast is found. Sterility and other disturbances in ovarial functions existing for the last ten years are brought into connection with an accumulation of thorotrast in the RES in the ovary. The primary α radiation of the thorotrast and the ten-times stronger secondary irradiation occurring through x-ray treatment for diagnostic purposes are held responsible. The author demands the prohibition of thorotrast as a contrast substance in x-ray therapy. 69 references.

1935 Experimental Beryllium Poisoning. W. N. Aldridge, J. M. Barnes, and F. A. Denz. Brit. J. Exptl. Path. 30, 375-89(1949) Oct.

The results of investigations on albino and hooded rats, mice, and rabbits to determine the mode of action of beryllium and the genesis of the profound tissue reactions it produces are described. Beryllium sulfate, oxyfluoride, and

BIOLOGY AND MEDICINE

lactate were used and, in addition, ammonium beryllium oxalate and sodium beryllium tartrate and malate were prepared for certain experiments. It was determined that the lethal dose of beryllium injected intravenously into the rabbits, rats, and mice as solutions of the ionized salts is 0.5-1 mg/kg; death takes place 1 to 3 days later and is the result of acute liver necrosis; it is claimed that neither the toxic properties of the anionic component nor the acidity of the beryllium salt solutions are responsible for these deaths. Beryllium collects in the liver sinusoids. Beryllium ions rapidly attach themselves to protein, and in this form are carried to the liver after an intravenous injection; but, following a subcutaneous injection, the ions tend to remain for long periods of time attached to tissue proteins. It was found that beryllium salts produce inflammatory changes in tissues after injection of inhalation, but most of the beryllium is fixed to the tissues, and only large doses cause the liver necrosis which leads to death. 15 references. (auth)

1936 Fluoroacetate Poisoning. A Review and Report of a Case. D. Carleton Gajdusek and Gertrude Luther. Am. J. Diseases Children 79, 310-20(1950) Feb.

A review and a report of the only case of human poisoning with fluoroacetate on record (the authors claim) are presented in this article. A 2-year-old Negro boy ingested crystals from a rat poison bottle containing the fluoroacetate (CH_2FCOON_a); almost immediately he vomited and continued to do so frequently; six hours after ingestion the child began to have generalized convulsive movements and became stuporous. Upon arrival at the hospital he was in tetany, comatose, and exhibited carpopedal spasm and tetanic convulsive movements, irregular respiration and great cardiac irregularity. A dose of 0.5 g of 5% solution of calcium gluconate intravenously was administered, and a continuous intravenous infusion of isotopic sodium chloride solution was begun; the tetanic convulsive movements stopped immediately. On the following day tonic convulsions occurred at frequent intervals; about 100 hr after ingestion of the poison the child became alert and on the evening of the sixth day he was clinically well; he then recovered without sequellae. The clinical picture presented here is briefly compared with that seen in experimental poisoning of animals.

1937 The Fluoroses. René Truhaut. Paris, Editions Sedes, nd. 127p. (in French).

The term "fluoroses" is used by the author to designate a chronic poisoning produced in man or animals by the fluorine derivatives. The author studies, first, the principal fluorine compounds used in industry, then analyzes the toxic symptoms produced by these compounds. He outlines the safety measures necessary to prevent fluorine poisoning in the various industries employing these compounds, and discusses the treatment of such poisoning. A third section of this book is devoted to the study of those analytical reactions of the fluorine ion which find application in research on fluorine toxicology. The results of investigations on the localization and elimination of fluorine derivatives are described. In conclusion the author tries to establish criteria to distinguish between normal and toxic concentrations of fluorine in various types of organisms.

1938 Fluorosis with Report of an Advanced Case. Leslie G. Kilborn, T. S. Outerbridge, and Hai-Peng Lei. Can. Med. Assoc. J. 62, 135-41(1950) Feb.

BIOLOGY AND MEDICINE

The effects of a high fluorine intake on the human skeletal structure are described. In the case reported, fluorine was absorbed by a Miao in China through drinking water, and the effects noted on the skeleton were profound: marked thickening of all the bones, which were very porous and brittle, occurred; the flat bones were about twice the normal thickness and the long bones were somewhat increased in diameter. Anatomical prominences, ridges, and places of muscle attachment were very much exaggerated. The vertebrae were fused to make the spinal column one long, rigid bone; all the intervertebral discs were completely ossified, while the sacrum and atlas were immovable. There was also a striking increase in the weight of the bones. References are given to similar studies on fluorosis by other investigators. 16 references.

1939 The Acquisition of Isotopically Labeled Inorganic Phosphate by the Tapeworm, Hymenolepis Diminuta, with Some Remarks on the Host-Parasite Relationship. Clark P. Read. J. Parasitol. 36, 34-40(1950) Feb.

A study was made of the uptake, in vivo, of isotopically labeled (P^{32}), inorganic phosphate by the cestode Hymenolepis diminuta. When trace doses of labeled phosphate were administered by stomach tube to starved host rats, the maximum activity of host gut mucosa was reached in about 70 min while the maximum activity in the worm tissues was reached in 85-90 min. In host rats given glucose with the trace dose of phosphate, maximal mucosal activity was attained in about 90 min while the activity in worms from these rats increased slowly with time. The uptake of parenterally administered labeled phosphorus by worms in either starved or post-absorptive host rats was similar, showing a steady increase in P^{32} content with time. (auth)

1940 Applications of Atomic Energy to Biology and Medicine. W. Edward Chamberlain. Clin. Proc. Jewish Hosp. 2, 27-32(1949) Sept.-Dec.

The uses of radioisotopes in diagnosis, therapy, and in tracer techniques are discussed. Among the radioisotopes mentioned are P^{32} and I^{131}, the former utilized in determining blood circulation times and in the treatment of certain widespread malignancies, and the latter finding application as a tracer in determining the activity of the thyroid and as a therapeutic agent in the treatment of various thyroid disorders.

1941 Artificial Radioactivity. J. W. T. Spinks. Can. Med. Assoc. J. 62, 120-2(1950) Feb.

The production and use of some of the radioactive tracer elements are described; the applications of P^{32} are particularly emphasized, and among the applications mentioned are soil experiments on the rate of uptake of P^{32} in fertilizers, phosphorus metabolism in laying hens, and the radiation effects of this tracer on the production of mutations in wheat and other plants. Radiocobalt is mentioned in connection with experiments on the habits of wireworms and cobalt deficiency in sheep; organic insecticides labeled with isotopic carbon are also mentioned. In summary, it is emphasized that one of the most important present applications of atomic energy is in the production of the radioisotopes for a great variety of tracer studies. The genetic effect of the radiations from the isotopes is also studied.

BIOLOGY AND MEDICINE

1942 Concerning the Physiology of Fracture Healing. I. Communication. On the Use of Radioactive Indicators in Investigations on the Healing of Bone Fractures. Fritz Ruf, Kurt Philipp, and Thor Halse. Langenbeck's Arch. u. Dtsch. Z. Chir. 263, 417-24(1950) (in German).

Rabbits and guinea pigs were injected at different intervals with 50 to 100 μc of radioactive P^{32}; the distribution of P^{32} in the organs, especially normal bone, bone muscle, fractured and healing bones, and fracture-muscle, as well as in the blood was recorded. The fractured bone, particularly the callus region, contained much higher amounts of P^{32} than normal bones, where P^{32} was mainly concentrated in parts of the epiphyses. The P^{32} values showed corresponding curves for normal bone and normal bone muscle on the one hand, and for fracture-muscle and callus on the other, indicating a distinct relationship and interdependence. The P^{32} concentrations were also shown in radiograms of fractured bones. 16 references.

1943 Determination of Blood Volume in the Heart and Lungs and the Cardiac Output through the Injection of Radiophosphorus. Gustav Nylin and Hjördis Celander. Circulation 1, 76-83(1950) Jan.

This report describes a method for the estimation of cardiac output and blood volume of the heart and the lungs by the use of erythrocytes labeled with radioactive phosphorus, P^{32}. A sample of venous blood, taken from the patient to be studied, was incubated with P^{32} present in the form of sodium acid phosphate, and a quantity of the labeled material was injected into the antecubital vein; arterial blood was then serially sampled at short intervals, and the concentration of the isotope was determined and drawn up as a function of the time. The characteristics of the dilution curve plotted were noted, and a formula was derived from the analysis of the data which facilitates the estimation of the cardiac output obtained from the curve. Other formulas are also presented which allow the estimation of the upper as well as the lower limits of the blood volume in the heart and lungs. It is estimated that 29 to 35% of the total blood volume is contained in the heart and lungs according to the measurements.

1944 Distribution of Radioactive Gallium in the Teeth and Jaws of Experimental Animals. James A. English and H. C. Dudley. J. Dental Research 29, 93-100 (1950) Feb.

This article is based on the Naval Medical Research Institute Report No. NM-008-009-Report 1. An abstract of the Report has been listed in Nuclear Science Abstracts as abstract No. 3-1180.

1945 The Precipitin Reaction and Antibody Valence Studied with the Aid of Radioactive Isotopes. T. E. Banks, G. E. Francis, W. Mulligan, and A. Wormall. Nature 165, 111-12(1950) Jan. 21 (Letter to the editor).

The use of radioisotopes for immunochemical investigations is discussed and several examples of the methods utilized are presented. The authors state that they have used lipovitellin containing P^{32}, proteins treated with mustard gas sulphone containing S^{35}, and iodinated proteins containing I^{131}; antibodies labeled with I^{131} or S^{35} were also utilized. The introduction of the radioactive tracers into the antibodies

BIOLOGY AND MEDICINE

does not destroy their ability to form specific precipitates with appropriate antigens. A few typical results obtained in experiments with iodinated ovalbumin containing I^{131} and an antiserum against iodinated protein are given in an accompanying table, and concern mixtures with excess antigen, antibody, or equivalent amounts of each. It was determined from the experiments described that the amount of inhibitor in the antigen-antibody-inhibitor systems studied was very small or possibly zero. It is believed that the results offer strong support for the view that the antibodies studied are univalent in the sense that each molecule has only one specific combining group for the corresponding antigen. A more complete account of the results of these studies will be given elsewhere.

1946 Radioactive Phosphorus as an Indicator of the Rate of Phospholipide Formation in Patients with Liver Disease. David Cayer and W. E. Cornatzer. Gastroenterology 14, 1-10(1950) Jan. (See also NSA 3-601).

Eleven patients having clinical evidence of advanced portal cirrhosis were studied with the aid of P^{32} for the purpose of determining the clinical efficacy of some lipotropic agents for the treatment of some liver diseases. The radioactivity of the phosphorus in the plasma lipids, with and without liver treatment by choline and methionine, was determined by blood samples taken 6, 48, and 96 hr after the intramuscular injection of the P^{32}. After two months of treatment with methionine, several of the patients were retested and it was found that in certain instances the lipotropic factors had a beneficial effect, largely due to the stimulation of the phospholipid formation. In normal persons, the rate of phospholipid turnover showed considerable variation. In two untreated patients with cirrhosis, an increase in plasma phospholipid turnover was demonstrated following a single large dose of choline or methionine, but no such effect was apparent after these patients had been treated with methionine. It is suggested that a definite increase in phospholipid turnover following a single large dose of choline or methionine may indicate fatty infiltration of the liver, and perhaps provide an indication of the need for treatment with lipotropic substances. 12 references. (auth)

1947 Seventh Congress of French-speaking Medical Electro-Radiologists. Held October 10-15, 1949 at Paris. Presse med. No. 73, 1073-4(1949) Nov. 19. (in French).

The theme of this meeting was Utilization of Radio-Isotopes in Diagnosis and Therapy. Some applications of radioisotopes in diagnostics and therapeutics were briefly considered. Among these applications are: the utilization of selective P^{32} for the diagnosis of tumors of the skin and for the localization of cerebral tumors; the use of I^{131} for the diagnosis of thyroid tumors and localization of thyroid metastases; the application of Na^{24} for the study of cardiac function and the condition of the peripheral blood vessels; and, the utilization of radiocobalt as an economical and effective agent in the treatment of cancer. Radiocobalt and the other isotopes are considered as valuable adjuncts to standard radiotherapeutic procedures. Several papers were presented.

1948 Some Remarks on the Use in Biology and in Medicine of Artificial Radioactive Elements. A. Couceiro.

BIOLOGY AND MEDICINE

Med., Cirurgia, Farmácia (Rio de Janeiro) 147, 371-95 (1948)(in Portuguese).

A general survey of the use of radioisotopes in biology and medicine is presented. After a discussion on pertinent physical items the author explains the meaning of isotopes and the methods employed in producing them; a detailed description of measuring instruments is included. The method of autoradiography of tissues is described and the fact is emphasized that Becquerel as early as 1895 formulated the concept of radioactivity in the photographic effect of the rays emerging from certain elements. The employment of radioactive isotopes in therapy is also noted and illustrated with colored photographs.

1949 The Use of Radioactive Iodine in Studying the Pathologic Physiology of Thyroid Disease. Rulon W. Rawson. J. Clin. Invest. 28, Pt. 1, 1330-46(1949) Nov.

The purpose of this paper is to review the contributions made to our knowledge of human thyroid disease by studies with radioactive iodine. Physiological levels of study never before obtained have been made possible through the use of radioactive iodine isotopes. Better concepts have been provided concerning the actions of certain thyroid stimulators and inhibitors, the function and biology of benign and malignant neoplasms of the thyroid, and a possible mode of action of the thyroid hormone on the tissues of the body. The thus far completed studies are concluded to be in harmony with previous observations obtained through conventional biochemical techniques. It is suggested that the radioactive studies are only the beginning of new and intensive investigations on normal and morbid physiology of the thyroid which will not only lead to a better understanding of thyroid disease but may also result in more intelligent therapy of these maladies. 49 references.

1950 The Use of the Stable Isotope, Heavy Carbon, in the Study of Intermediary Metabolism. Marian Edna Swenseid. p.150 in Summaries of Ph.D. Theses. University of Minnesota, Vol. IV. Minneapolis, 1949.

The variations of the concentration of C^{13} occurring naturally in mice are discussed; it was found that in no animal fraction isolated, with the possible exception of expired CO_2, was there a large variation from the average value of the tissues. Biological studies with $C^{13}O_2$ were carried out by utilizing two general types of experiments: mice either were injected with heavy sodium bicarbonate or placed in an atmosphere containing heavy carbon dioxide. The $C^{13}O_2$ did not appear to be bound in organic combination in any fraction which was isolated except that of urea, and more than 90% of the bicarbonate C^{13} was recovered in the expired $C^{13}O_2$, in the urinary bicarbonate, and in the inorganic body carbon in fasting and fed mice 8 hr after injection. After C^{13}-containing acetic acid was fed to fasting rats for 3 days, the urinary acetone contained excess C^{13}, indicating the formation of acetone bodies from acetic acid. Sodium bicarbonate containing C^{13} was fed to fasting rats and it was found that the urinary acetone bodies did not contain excess C^{13}; more $C^{13}O_2$ was expired by a fasting mouse during an 8-hr period after a sodium acetate injection than in a 10-hr period by a fed mouse.

1951 The Use of Stable Isotopes in Biological and Medical Research. Irving M. London. J. Clin. Invest. 28, 1255-70(1949) Nov.

BIOLOGY AND MEDICINE

This paper is designed to indicate some of the types of investigative problems for which tracers are particularly suited and to present illustrative examples of studies in which stable isotopes have been used. Problems of dilution and transport, conversion, kinetics of biochemical reactions and similar topics are discussed here. It is concluded that despite the relatively short period of time during which isotopes have been available, tracer techniques have exerted a considerable influence on biochemical thought and practice. Two principle developments are considered to have developed from this stimulated interest or are due in part to the tracer techniques. It has become evident that complex organic substances to a large extent are synthesized not from compounds of similar complex configuration but rather from small compounds of simple structure. The extensive participation of glycine and acetic acid in biosynthetic processes is concluded to have focussed attention on the biochemical versatility and significance of small simple compounds. The outstanding contribution of isotopic methodology is considered to be the development of the concept of the dynamic state of the body constituents. The implications of this concept represent a major advance toward an understanding of the processes which occur in the living cell. 69 references.

CHEMISTRY

1952 The Chemistry of Ruthenium; Annual Report Covering the Period June 1, 1948, to August 31, 1949. Martin Kilpatrick, Mary L. Kilpatrick, Richard C. Vogel, and Edward H. Kobish. AECU-652(M-4444), nd. 45p.

Solutions of $Ru(ClO_4)_4$ in perchloric acid were prepared by metathesis of $Ru(SO_4)_2$ with $Ba(ClO_4)_2$. Solutions of ruthenium(IV) perchlorate of concentrations less than 0.02 moles per liter were found to be stable up to 40°C but decomposed at 100°C. The kinetics of the complexing of ruthenium(IV) ion with chloride were investigated, and the rate of complexing was found to be first order in ruthenium(IV) and in hydrogen ion but higher than first order in chloride ion. A kinetic analysis of the preliminary results indicates that the reaction mechanism is not a series of consecutive irreversible reactions involving chloride ion but may be a pre-equilibrium and at least two simultaneous reactions. (auth)

1953 Mercury Drop Control: Application to Derivative and Differential Polarography. L. Airey and A. A. Smales. Atomic Energy Research Establishment Report No. AERE-C/R-421, Sept. 1949. 23p.

Controlled disengagement of a mercury drop may be achieved either by the abrupt application of an electrical pulse to reduce the interfacial tension, or by a small lateral movement of the capillary, effectively "shearing" the drop from the mercury thread. The fundamentals of the two techniques are examined, and it is concluded that the mechanical method possesses marked advantages. The modifications of a standard Cambridge Polarograph to permit of operation either normally or as a bridge circuit for multiple electrode work, as required, is described and illustrated. The performance of the bridge circuit as used for both derivative and differential working is examined theoretically and practically. Illustrative examples of the utility of the two techniques are given. Possible future developments are

CHEMISTRY

briefly discussed and some observations on the Ilkovic equation are included. (auth)

1954 The Arc Spectrum of Fluorine. Kurt Linén. Arkiv Fysik 1, 229-67(1949).

The arc spectrum of fluorine, F I, has been investigated in the infrared, visible, ultraviolet, and vacuum regions using suitable types of water-cooled hollow cathode discharge tubes as light sources. About 370 new lines have been identified and 67 new energy levels established. The ns- and dn-series can be unambiguously assigned to the components of the limit ^3P and they show almost perfect $J_l l$- or pair-coupling. Series of ns- and nd-levels are in excellent agreement in fixing the series limits within ± 0.1 cm^{-1}, giving an ionization potential of 17.418 volts. The hyperfine structure has been studied with the Fabry-Perot interferometer and the strongest lines have been interferometrically measured against Ne I standards. (auth)

1955 Organic Fluoro-compounds. Part I. Hydroxy-derivatives of Benzotrifluoride. W. B. Whalley. J. Chem. Soc., 3016-20(1949) Nov.

The preparation of 3:5-dihydroxy-, 2:5-dihydroxy-, 3-hydroxy-4-methoxy-, and 2:5-dihydroxy-4-methoxy-benzotrifluoride and several derivatives thereof is recorded. (auth)

1956 A New Type of Pipette for Radioactive Solutions. A. J. Swallow. Nature 165, 249(1950) Feb. 11 (Letter to the editor).

A pipet has been so designed as to obviate the danger of drawing dangerously radioactive solutions into the mouth. A small side arm is sealed onto an ordinary pipet, and covered by a rubber bulb. Liquid is drawn into the pipet by covering the top of the tube, compressing the bulb, placing the open end of the pipet in the liquid and releasing the bulb.

1957 Solvent Extraction of Inorganic Ions; Third Quarterly Progress Report. L. G. Bassett, S. E. Wiberley, J. Savolainen, H. M. Clark, and Sydney Ross. RPIB-3, Nov. 1, 1949. 32p.

Work has continued in the attempt to correlate the structure of organic solvents with their ability to extract inorganic ions. A study of the infrared absorption spectra of dimethyl ether in CCl_4 saturated with HCl shows further evidence of the bonding of the proton of the HCl to the C-O group. This verifies previously reported data obtained with diethyl and isopropyl ethers. A study of the spectra of several inorganic salts, $Fe(NO_3)_3$, $Th(NO_3)_4$, $UO_2(NO_3)_2$, in various ethers indicates a similar behavior of the inorganic cations. It appears that one of the factors involved in the solubility of inorganic ions in oxygenated organic solvents may be attributed to the ability of the oxygen of the solvent to combine in some manner with the inorganic ion concerned. Refractive indexes of solutions of varying $(Fe^{+3})/(Cl^-)$ are being obtained by a new method less subject to minor variations in experimental technique. This method is based on the additivity of the refractive index. Two solutions, one of HCl and the other of $FeCl_3$, of such concentrations that both have the same refractive index R_0, can be mixed to make a series of samples with varying $(Fe^{+3})/Cl^-)$. A change in refractive index from R_0 is indicative of complex formation. (auth)

CHEMISTRY

1958 The Production of Sodium Formate-C^{14} by the Lithium Borohydride Process. J. G. Burr and H. E. Heller. ORNL-396, Dec. 13, 1949. 19p.

A method has been developed for the preparation of sodium formate-C^{14} by the reduction of carbon dioxide-C^{14} with an ethereal solution of lithium borohydride at 0°C. The method is equally applicable to low level synthesis using simple laboratory equipment and to high-level routine production. By-products of the reaction are methanol (10-15%) and diborane. The mechanism of the reaction has as yet no simple interpretation. Ethyl formate can be prepared in good yield from the sodium salt by the action of diethyl sulfate at 170°C. A special apparatus has been built for routine production, which permits carefully controlled reaction conditions in an enclosed system. By this method 130 mc of high specific activity sodium formate has been prepared. (auth)

1959 Experiments with Paper Chromatography of the Animal Phospholipids. J. O'Leary and W. F. Neuman. UR-100, Dec. 9, 1949. 22p.

Two experiments are described in which mouse and rat phospholipid extracts were separated into six or more component bands by means of filter paper chromatography using P^{32} as tracer. Such bands of separated material were not identified as phospholipid entities. The greatest difficulty in the paper chromatography of phospholipids was the lack of reproducibility. The general behavior of a fairly wide variety of solvents has been demonstrated, and those solvents which hold promise have been indicated. Among these are chloroform-butanol mixtures, chloroform-octanol mixtures, and mixtures of higher aliphatic alcohols generally. Improvements in method and possibilities for its application are discussed. (auth)

1960 Self-Diffusion and Ionic Conductivity of the Sodium Ion in Sodium Bromide. H. Nelson Crooks. Carnegie Institute of Technology Technical Report No. 12, Aug. 1949. 77p. (NP-1241.)

Radioactive tracer methods with Na^{24} have been used to measure directly the self-diffusion coefficient of the sodium ion in single crystals of sodium bromide at temperatures between 325 and 700°C. The values obtained have been compared with values calculated from the measured electrical conductivity using the Einstein relation. It is observed that the Einstein relation is satisfied at temperatures above 400°C, but that below 400°C the values measured directly are higher than those calculated from the electrical conductivity. The hypothesis of Mapother, that this failure of the Einstein relation is due to the presence of mobile complexes formed by the combination of multivalent ions and positive-ion vacancies, is re-examined and the conclusion reached that the experimental evidence is insufficient to prove or disprove it. A derivation of the Einstein relation and a derivation of the diffusion equation and its solution are appended. 16 references. (auth)

1961 The Use of Radio-Elements and Stable Isotopes as Tracers in Non-Biological Chemistry. M. Schacht. Angew. Chem. 61, 465-70(1949) Dec. (in German).

This is a review article dealing with the use of tracers in inorganic, organic, and physical chemistry. In particular the following applications are described: the investigation

CHEMISTRY

of structures and reaction mechanisms, exchange reactions, the emanation method, surface layer investigations and colloid chemistry, and soil investigations. More than 60 references to the literature.

1962 Infrared Spectra of Uranyl Salts. A. N. Sevchenko and B. I. Stepanov. Zhur. Eksptl. i Teoret. Fiz. 19, 1113-20(1949)(in Russian).

An investigation of absorption spectra of four uranyl salts, in the region between 5 and 14 μ, showed the presence of a number of higher harmonics and combination frequencies. These could be interpreted by taking as fundamental frequencies 830, 200, and 920 cm^{-1}. It follows from a comparison of the band intensities with data furnished by the selection rules, that in uranyl sulphate and uranyl-potassium sulphate the UO_2^{++} ion has a bent shape, while in uranyl acetate and uranyl nitrate it is almost rectilinear. The influence of the water of crystallization on the relative intensities of various bands was noted. The bands' frequencies do not vary with the quantity of water of crystallization. (auth)

1963 Recovery of Uranium. Arnold Pocyna. U.S. Patent 2,485,841, Oct. 25, 1949.

A process is described which allows recovery or extraction of vanadium and uranium compounds from ore, particularly carnotite, usually as oxides. The ore is first finely ground then oxidized with $CaOCl_2$; the mixture is treated with HCl or H_2SO_4 to liberate the oxidizing agent, heated to dryness and until HCl is expelled, and cooled; ammonium chloride is then added to preserve the formed thioglycollate. Iron, vanadium and uranium are precipitated from solution by adding sodium carbonate. Such subsequent steps as ignition of organic impurities, addition of sodium nitrate, fusion, lixivating, precipitation of the Al compounds, filtering, acidifying, boiling, alkalizing, and separating render the desired products.

ENGINEERING

1964 The D. C. Electromagnetic Pump for Liquid Metals. J. Woodrow. Atomic Energy Research Establishment Report No. AERE-E/R-452, Dec. 1949. 14p.

The general theory of an ideal pump is developed, expressions being derived for the current and flux distributions, pressure developed, and the efficiency. The efficiency is found to depend on three nondimensional parameters. A very important special case is the pump developing maximum pressure at the outlet. The theory is applied to the case of a pump for liquid sodium. (auth)

1965 Floor Waxes; Six Brands of the Water-Emulsion Type Tested. Consumers' Research Bulletin 25, 21-3(1950) Mar.

Floor waxes tagged with Co^{60} were tested for wearing qualities by measuring residual activity after wax coating on linoleum was given wear test.

1966 Leak Detection. Taber de Forest (to Joseph L. Switzer and Robert C. Switzer). U. S. Patent 2,472,522, June 7, 1949.

A method is described of detecting incipient leaks in high vacuum systems containing transparent walls. Fluorescent

ENGINEERING

liquids are applied to one surface of the vacuum system, are pulled through to the opposite surface through the leaks, and then betray the location of the leaks by their fluorescence. Examples of satisfactory fluorescent fluids given are the following:

a) Ethylene glycol monobutyl ether	99.5%
Ethyl ester of meta mono ethyl-amino-phenol phthalein	0.5
b) Tri-ethylene glycol	49.8
Octylalcohol	50.0
Fluorescein sodium salt	0.2
c) Kerosene	94.75
"Fluorol 5 GA"	0.25
Kerosene-soluble naphthenic acid soap	5.0

1967 Vacuum Tight, Flexible Metal Glass Seal. Kenneth M. Sancier. Rev. Sci. Instruments 20, 958(1949) Dec. (Shop notes).

A sleeve of Saran tubing can be used to form a vacuum tight, flexible seal between metal or glass tubing. The thermoplastic Saran tubing heated to the softening point is slipped over the hot metal or glass tubing. Further heating with finger pressure completes the bond between plastic and rigid tubing. Such a seal can be used for a vacuum of about 10^{-5} mm or better, and any small leaks can be covered with glyptol.

MINERALOGY, METALLURGY AND CERAMICS

1968 The Age of Uraninite from Gordonia, South Africa. With an Isotopic Analysis of Lead. Arthur Holmes, W. T. Leland, and A. O. Nier. Am. J. Sci. 248, 81-94(1950) Feb.

The age of uraninite from a post-Kheis pegmatite in Gordonia, South Africa, hitherto known only within wide limits (Holmes, Am. J. Sci. 27, 343(1934)), is discussed afresh in the light of an isotopic analysis of Pb separated from a sample previously analyzed by Hecht (Am. J. Sci. 27, 321(1934)). From the apparent ages calculated from AcD/RaG, RaG/U, and AcD/U, respectively, the nature of the alteration of the mineral is inferred and the most probable age is found to be 1025 ± 10 m.y. The "age" calculated from ThD/Th is anomalous. It is shown that unsystematic discrepancies of this kind are usual in all fully investigated radioactive minerals, implying that Th and/or Pb have suffered differential loss or gain, or that Th has not been accurately determined, or both. Crude age estimates of post-Karagwe-Ankolean euxenite from Uganda and of post-Damara lepidolites from South-west Africa (Ahrens, Bull. Geol. Soc. Am. 60, 218 (1949)) suggest, as a working hypothesis, that the intensely folded sediments of the Kheis, Damara, Kibara, Urundi, and Karagwe-Ankolean Systems may all belong to a single orogenic belt extending from South Africa to Uganda. (auth)

1969 Age of Uraninite from a Pegmatite Near Singar, Gaya District, India — With an Isotopic Analysis of Lead. Arthur Holmes, W. T. Leland, and A. O. Nier. Am. Mineral. 35, 19-28(1950) Jan.-Feb.

The age of an analyzed specimen of uraninite from one of the pegmatites of the micabelt of Bihar, India, is rediscussed in the light of the isotopic constitution of lead separated from the residue of the analyzed powder. The data are found to be insufficient to yield an unambiguous solution and the age

MINERALOGY, METALLURGY AND CERAMICS

cannot be stated more closely than 955 ± 40 m.y. The evidence is ample, however, to prove that the Bihar pegmatites, representing the end-stage of the Satpura orogenic cycle, are older than those of the Delhi cycle, already dated by a uraninite from Rajputana of which the age is 735 m.y. It is shown from tectonic considerations, combined with the above age estimates and tentatively supported by less reliable indications from the radioactive minerals of the Nellore district, that the sequence of the main Pre-Cambrian orogenic belts of India is (1) Delhi, (2) Satpura, (3) Eastern Ghats, (4) Dharwar. The Aravalli belt is older than the Delhi and Satpura belts and may be a continuation of the Dhawar belt. (auth)

1970 Distribution of Radioactivity in Granites and Possible Relation to Helium Age Measurement. Patrick M. Hurley. Bull. Geol. Soc. Am. 61, 1-7(1950) Jan.

Granulated samples of acidic igneous rocks have been found to give a much higher rate of emission of α particles than corresponds to the known total contents of uranium and thorium. Abnormally large residual ranges of the α particles suggest a surficial distribution of the radioactive elements on the surfaces of the granules in the form of secondary mineral coatings. Most of the α-particle activity can be removed by dilute hydrochloric acid, leaving an activity corresponding to the low content of uranium and thorium found in sandstones and arkoses, in which the essential mineral grains of granites have been rounded and cleaned by attrition. The proportion of surficial activity appears to be less for granite samples taken from considerable depth below the surface than for samples from the zone of surface-water saturation. Losses of activity by acid treatment appear to be related to the degree of retentivity of helium in different igneous rock types. Determination of the helium age ratio before and after acid treatment suggests that the essential rock minerals contain as much helium as they should commensurate with their age and with the quantity of radioelements uniformly distributed within them, and not removable by acid. The low ratio of helium to radioactivity for the rock as a whole may be due either to loss of helium from highly radioactive areas that are easily affected by acid and thus also probably by ground waters, or to actual supergene enrichment of radioelements late in the history of the rock. (auth)

1971 Fundamental Research in Physical Metallurgy; Fourth Quarterly Progress Report. J. H. Hollomon and D. Turnbull. GEPM-17, Jan. 1, 1949. 13p.

The status of the following studies is reported: self-diffusion in silver; method for casting copper-silver alloys; sintering of small wires; diffusion preparation of the compound NiAl; activity coefficients in solid solutions of copper and silver by the partition method and by the EMF method; a high temperature calorimeter; interfacial energy, etc.

1972 Development of Zirconium Base Alloys. Fourth Quarterly Report (Fifth Progress Report). R. W. Hennig and J. D. Nisbet. GEZR-5, Jan. 1, 1950. 8p.

A report on zirconium arc melting during the last quarter of 1949 is made. Newly designed equipment for preparing refractory alloys is described and plans for future work are outlined. (auth)

MINERALOGY, METALLURGY AND CERAMICS

1973 Solid Solutions and Grain Boundaries. Technical Progress Report No. 2, Scope II. B. L. Averbach, L. Seigle, and M. Cohen. MITX-4, Nov. 8, 1949. 9p.

The present report outlines the experimental work being carried on to measure the thermodynamic properties of metallic solid solutions. In multicomponent systems of the type under consideration, the thermodynamic properties are usually determined by measuring the free energy of mixing as a function of temperature and composition. Vapor pressure measurements and EMF measurements with Ag-Zn alloys are discussed.

1974 Solid Solutions and Grain Boundaries. Technical Progress Report No. 3, Scope II. B. L. Averbach, L. Seigle, and M. Cohen. MITX-5, Dec. 5, 1949. 6p.

The fundamentals of solid solutions and grain boundaries are being investigated in order to better understand the energy changes and mechanisms involved in solid-solid phase transformations. Experimentally this involves determinations of the thermodynamic properties of solid solutions and the correlation of these properties with the equilibrium atomic configurations. In this respect, two types of solid solutions are of special interest: solutions which decompose into two phases on cooling, and solutions which become ordered. The thermodynamics for each of these solutions has been predicted, and this program has undertaken an experimental verification and a physical interpretation of the existing theory. The present report details some preliminary work on the nickel-gold system.

1975 Solid Solutions and Grain Boundaries. Technical Progress Report No. 4, Scope II. B. L. Averbach, L. Seigle, and M. Cohen. MITX-6, Dec. 6, 1949. 3p.

Details of experimental work to determine thermodynamic activities in Ni-Au solid alloys by means of EMF measurements are discussed.

1976 Measurement of Poisson's Ratio of Beryllium with Electric Strain Gages. H. C. Savage. ORNL-524, Feb. 6, 1950. 16p.

The results of a limited investigation of Poisson's Ratio, Modulus of Elasticity, and the Modulus of Rigidity (Shear Modulus) of beryllium are presented in this report. Electric strain gages were used to measure unit lateral and axial strain in specimens of extruded and QM beryllium in tension and compression. For the limited number of pieces tested the following results and conclusions are reported. Poisson's ratio was measured as 0.020 to 0.060 at stresses under 5,000 psi. Up to 12,000 psi (maximum stress used) Poisson's ratio increased to 0.10 to 0.13. The modulus of elasticity was found to be between 36×10^6 psi and 45×10^6 psi in tension and compression for extruded beryllium (both transverse and longitudinal) with stresses up to approximately 7,000 psi. A few exceptions were noted above 7,000 psi where the value of E decreased to about 30 to 35×10^6 psi. The modulus of rigidity (shear modulus) as determined from Poisson's ratio and the modulus of elasticity is between 17×10^6 psi and 22×10^6 psi with few exceptions noted for extruded beryllium. For one sample of QM metal tested, a value of Poisson's ratio of 0.020 to 0.050 in both tension and compression was obtained. On the initial tensile test a value for E of 41 to 50×10^6 psi was obtained. A compressive test on the same piece gave a value of 17 to 25×10^6 psi

MINERALOGY, METALLURGY AND CERAMICS

for E. Two subsequent tensile tests gave values for E of 26 to 35×10^6 psi. A number of tests on additional samples would be required to establish a better working value for the QM metal and to evaluate the effect of cold working, repeated loads, etc., on the physical properties. Electric strain gages (type SR-4) provide a rapid, but accurate method for strain measurements in both a longitudinal and transverse direction. When used in conjunction with a universal test machine or other accurate loading machine, very accurate measurements of physical properties of various materials can be made. (auth)

1977 Compressive Properties of Titanium Sheet at Elevated Temperatures. Paul F. Barrett. National Advisory Committee for Aeronautics, Technical Note 2038, 1-10(1950) Feb.

Results are presented of compressive stress-strain tests of titanium sheet at temperatures from room temperature up to 800°F, exposure times of ½ to 2 hr, and strain rates of 0.002 to 0.006/min. The results show that titanium has favorable compressive properties, comparable to those in tension, up through 800°F. Marked anisotropy in compression was also noted. (auth)

1978 Developments of Germanium and Gallium during 1949. John R. Musgrave. J. Electrochem. Soc. 97, 8C(1950) Jan.

The use of germanium in electronic apparatus is described briefly and the possibility of using gallium as a heat transfer agent in the atomic pile is discussed. This application of gallium is held to be impractical because of the high price and the difficulties encountered in working with the element. It is stated, however, that considerable research work now being done with gallium may lead to new and unexpected uses for the element; one of the isotopes of gallium is being used in the study of bone cancer.

1979 Physical Chemistry of Gallium-Indium Alloys (Annual Technical Report, Oct. 1, 1947 - Sept. 30, 1948). J. Hugh Hamilton, John R. Lewis, and J. P. Denny. University of Utah, Sept. 30, 1948. 61p. (NP-1092.)

Certain gallium-lead, gallium-lead-bismuth, and gallium-indium compositions have been studied, with particular emphasis placed on the low melting alloys. The work has included thermal, chemical, and metallographic analyses. Experimental evidence shows rather conclusively that no gallium-lead-bismuth compositions are molten at room temperatures. This is attributed to limited solubility of lead-bismuth alloys in liquid gallium, at the gallium melting point. Eutectic temperatures indicated are Ga-Pb, 29.4°C, and Ga-Pb-Bi, 27.5°C. A method is developed for rapid determination of the gallium-indium eutectic composition. This consists in effecting a separation of the eutectic, by centrifuging at temperatures just above the eutectic temperature, and conducting chemical analyses on the separated constituents. Application of the method to ternary and higher order systems may be possible. If so, the method is far superior to the monumental task of determining high order eutectics by thermal analysis. In metallographic work on the system, gallium-indium, a suitable etching reagent has not been found; and this phase of the work is incomplete at the date of writing. Techniques developed to date, applicable to the study of low melting alloys, are discussed. 22 references. (auth)

MINERALOGY, METALLURGY AND CERAMICS

1980 Radioactivity at the Caribou Silver Mine, Boulder County, Colorado. G. Carman Ridland. Mining Engineering 187, 98-101(1950) Jan.

A radioactivity survey on the surface and within the Caribou mine in the mineralized areas of the Front Range, Colorado, brought to light some problems in the search for pitchblende bearing veins. The surface survey did not reveal any evidence of above normal γ-ray intensity over the country rock or along the outcrops of the veins. However, in the Caribou mine, at a depth of 1,040 ft pitchblende was discovered. At this level the anomaly first registered at a distance approximately 160 ft from the point where the nearest channel sample returned a value for uranium. Both on the surface and underground the quartz-monzonite host rock was found to possess a normal γ-ray count. This observation is in direct contradiction to results obtained from similar studies made in the Great Bear Lake area, N. W. T. Canada, where the host rocks of the silver pitchblende veins were found to be approximately one and one-half times as radioactive as the adjacent, nonhost formations. A graph is shown giving the profiles of the γ-ray intensities at the 360, 530, 920, and 1,040 ft levels of the Caribou mine. The first γ-ray response was obtained at the 920 ft level which was 3N counts as compared to 20N counts at the 1,040-ft level. The γ-ray intensities are expressed in the number of counts over the normal (N) background count of the country rock.

1981 Radium Content of Ultramafic Igneous Rocks. III. Meteorites. Gordon L. Davis. Am. J. Sci. 248, 107-11(1950) Feb. (See also NSA 4-703.)

Measurements of the radium content of some pallasites and iron meteorites have been made by a refinement of the vacuum fusion technique. In general, the radium content of the meteorites investigated is lower than that of terrestrial ultramafic rocks and minerals. Radium contents are also given for one stony meteorite and one amphoterite. (auth)

PHYSICS

1982 Physics Division Quarterly Progress Report for Period Ending September 25, 1949. A. H. Snell and E. O. Wollan. ORNL-481, Dec. 21, 1949. 59p.

Scintillation Spectrometry. Decay times of the light from phosphors have been measured as a function of temperature. For anthracene, the decay time extrapolates to zero at absolute zero. The possible influence of temperature upon the light transmission of the glass envelopes of the multiplier tubes is being investigated. The 5819 photomultiplier tubes are found to have photosurfaces which are not uniformly sensitive from region to region. A television-like scanning device has been developed by which these irregularities are quickly displayed on an oscilloscope screen. The resolution of the scintillation spectrometers has been improved so that the width of a conversion line at half maximum now is 13% of the energy of the line. The β and γ spectra of K^{40} and Er^{169} have been examined.

"Hot Lab" Manipulator. A small, inexpensive electric motor has been adapted so as to yield a drive that can be standardized and adapted to many varied tasks in remote manipulation.

Short-Lived Isomers. A new isomer has been found in Lu^{177}; the half-life is 13×10^{-8} sec. Observations made elsewhere of an isomeric level in Hg^{198} have not been confirmed. Application of scintillation spectrometry of the delayed coincidence work is beginning to yield information on the energy of the radiations from short-lived isomers.

Neutron Diffraction. The magnetic scattering observations have made it possible to derive the radial distribution of the five electrons in the 3d shell of Mn^{+2}. Agreement is satisfactory with the distribution as calculated for the self-consistent field analysis. Antiferromagnetic structure has been observed in MnO and MnSe at 80°K and in Fe_2O_3 at temperatures below its curie point at 675°C. Coherent scattering from several zero-spin nuclei has been studied for the purpose of improving the accuracy of the measurement of coherent scattering cross sections.

Neutron Polarization. A ⅝ in. diameter beam yielding 10,000 cts/min of 70% polarized neutrons has been produced. This will be used in the nuclear alignment experiments.

Cross Section of Gold. This has been remeasured with the neutron crystal spectrometer. For $E_n = 0.025$ ev, it is found that $\sigma_T = 103.5$ barns and $\sigma_s = 7.6$ barns.

Low Temperatures. It has been found possible to conduct heat at 0.30°K reasonably quickly from an object on one end of a silver bar to a magnetically-cooled lump of chrome alum on the other end of the bar. The observation is very encouraging, because it is this arrangement that is planned for use in part of the nuclear-alignment program.

Short-Period Activities. The fast pneumatic tube has been equipped with scintillation spectrometer detecting equipment, so that the energies of the short-lived activities can be measured.

Neutron Decay. Because of "improvements" in the apparatus, the data have lost some of their internal consistency.

Semi-Conductors. The resistance of germanium shows interesting variations as a function of temperature during and subsequent to pile irradiation. The germanium is so sensitive to impurities that even the transmuted atoms in the lattice produce major effects upon the resistance.

Van de Graaff. The electron accelerator has produced beams of 200 μa at 1.8 Mev, and smaller beams at higher voltage. Photodisintegration of beryllium is easily accomplished.

Theoretical Physics. Much work has been done on the preparation of the L-shell internal conversion coefficient calculation for feeding it to the Mark III computer. Calculations have also been carried out upon the effect of the finite size of the nucleus on β-decay, and its effect upon internal conversion. (auth)

1983 Calculation of Gas Viscosity as a Function of Temperature. LeRoy A. Bromley. UCRL-525, Nov. 1949. 11p.

Nomographs and a tabular function based on equations (Hirschfelder et al, J. Chem. Phys. 16, 968-81(1948)) and tables for nonpolar, smooth spherical molecules are presented, which allow easy, quick, and accurate extrapolation of gas viscosity. The method is restricted to gases at moderate pressures where viscosity is essentially independent of pressure. (auth)

1984 Hot-Cathode Arcs in Cesium Vapor. Richard K. Steinberg. M. I. T. Research Laboratory of Electronics Technical Report No. 128, June 17, 1949. 17p. (NP-1390.)

PHYSICS

A hot-cathode arc in cesium vapor has been studied by the use of a plane Langmuir probe to investigate the potential distribution, electron temperature, and electron density in the plasma. The range of arc currents and vapor pressures over which satisfactory probe measurements may be made are determined. In some cases it was possible to maintain the discharge with a total arc drop of less than the ionization potential of cesium (3.87 volts). Potential "humps" along the arc are shown to be absent, and ionization by the high-energy electrons of a Maxwellian electron velocity distribution is found unsatisfactory as a possible mechanism for positive ion production in the arc. The mechanism of successive electron collisions can account for the observed ionization on the assumption that the effective lifetime in the excited state is increased by the process of the imprisonment of resonance radiation. 14 references.

1985 International Congress in Nuclear Physics at Basel, Sept. 6-10, 1949. P. M. Marcus. Office of Naval Research, London Branch. Report No. OANAR-47-49, Nov. 29, 1949. 29p.

The Congress covered a wide range of subjects in the general fields of nuclear physics and quantum electrodynamics. About one-third of the papers were on instrument developments in ionization chambers, counters, ion sources, accelerators, etc.; a third on nuclear experiments, nuclear reactions, scattering experiments, atomic piles; and a third on theoretical developments in the structure and binding energies of nuclei, the radiative corrections to the theory of the electron, and the recent work in quantum electrodynamics. This report summarizes selected papers presented at the conference. In Appendix A is given a complete program of the meeting and in Appendix B a selected list of persons attending. (auth)

1986 Progress Report. M. I. T. Laboratory for Nuclear Science and Engineering. Jan. 1, 1950. 82p. (NP-1384.)

This is the fifteenth progress report of the Laboratory for Nuclear Science and Engineering at the Massachusetts Institute of Technology. Progress during the fourth quarter of 1949 is reported under the following group headings: chemistry of the fission elements group; cosmic ray group; elementary particle scattering group; 12-Mev generator construction and high voltage research group; nuclear chemistry (inorganic) group; nuclear chemistry (organic) group; nuclear cross sections group; radioactivity and cyclotron group; synchrotron group; theoretical group. (auth)

1987 Results of the Exact Natural Sciences. S. Flügge and F. Trendelenburg, Eds. Berlin, Goettingen, Heidelberg, Springer-Verlag, 1949. Vol. 22, 332p.

This volume contains review articles by various specialists, summarizing recent progress in a number of fields of physics. Included, among others, are the following: Transuranic Elements, S. Flügge. The Betatron, H. Kopfermann. Origin and Properties of the Cosmic Radiation, E. Bagge.

1988 The Second Radiation Constant in Planck's Radiation Formula. G. A. W. Rutgers. Physica 15, 985-9(1949) Dec.

The radiant intensity of a black body at the gold point has been measured for three wavelengths. From these measurements a value of Planck's second radiation constant $c_2 = 1.432_8 \pm 0.002$ cm degree is derived. The maximum luminosity factor was found to be 628 lm/watt, corresponding to a value of $c_2 = 1.431$ cm degree. A survey of experimental data shows, that the difference between the results of radiation measurements and the calculated value of c_2 amounts to about 3.5 pro mille. (auth)

1989 Production of Mesons by X-Rays. Edwin M. McMillan, Jack M. Peterson, and R. Stephen White. UCRL-445, Sept. 15, 1949. 15p.

A preliminary account (McMillan and Peterson, Science 109, 438(1949)(A)) has been given of some photographic emulsion observations of mesons produced in carbon by the 335-Mev x-ray beam from the Berkeley synchrotron. The present report is a progress report of this work. Some new data are presented, and some of the numerical results given previously are revised.

1990 The Lifetime of the Positive π Meson. E. A. Martinelli and W. K. H. Panofsky. UCRL-459(Rev.), Oct. 11, 1949. 22p.

The document is a revision of AECU-387 which has been listed in Nuclear Science Abstracts as No. 3-1223.

1991 Anomalies of the Absorption Curve of Cosmic Rays in Lead. E. Fenyves and O. Haiman. Nature 165, 244(1950) Feb. 11 (Letter to the editor).

Investigating the absorption of the vertical component of cosmic radiation in lead by means of a Geiger-Mueller counter-telescope, George and Appapillai (Nature 155, 726 (1945)) found in 1945 at sea-level (London and Colombo) that the absorption curve showed a plateau at about 10 cm absorber thickness. These experiments have been repeated under such conditions as to eliminate barometric and temperature effects (which proved to be important). A second anomaly was found between 20 and 30 cm of lead, in addition to the anomaly previously reported. At pressures between 750 and 760 mm mercury, a maximum was found in the absorption curve, within the plateau of George and Appapillai, at an absorber thickness of 26.6 cm. The height of the maximum is 2.5 times the standard deviation. The maximum shifts to smaller thicknesses at higher pressures, and larger thicknesses at lower pressures. It is noted that other workers have found maxima in the ionization curves of lead absorbers in roughly the same range of absorber thicknesses.

1992 Atmospheric and Astrophysical Factors and the Large Auger Showers. A Daudin and J. Daudin. J. phys. radium 10, 394-401(1949) Dec. (in French).

This paper presents a theoretical study of the influence of the density of the air (and therefore of its temperature) on the number of coincidences due to Auger showers. The barometric coefficient for such showers was measured at sea level and at the Pic du Midi with twice the accuracy of previous measurements. The same barometric coefficient was found with coincidence counters separated by 5 m and 75 m but measurements with the larger separation showed increased fluctuations greater than those which might be expected from the known physical and geometric factors. Some diurnal variation in the number of showers was noted, and is attributed to diurnal variation in the stellar configuration. This explanation implies that the galaxy contains

PHYSICS

sources of primary cosmic rays with energies up to the maximum observed cosmic ray energies.

1993 A Cloud-Chamber Study of Cosmic-Ray Nuclear Interactions at 3260 Meters Elevation. W. W. Brown and A. S. McKay. Phys. Rev. 77, 342-54 (1950) Feb. 1.

In 4949 photographs of cosmic-ray phenomena, not associated with dense air showers, occurring in a counter controlled cloud chamber surrounded by lead, the numbers of nuclear interactions in which secondaries were produced and observed to occur in and above the chamber were 182 and 223, respectively. The mean free path for nuclear interaction of the penetrating particles produced in these nuclear interactions is 316 ± 70 g/cm² of lead, while for nuclear scattering (large angle scattering without the production of secondaries) it is at least 4 or 5 times this value. The projected zenith angular distributions of the secondaries from these interactions are given. The lightly ionizing secondaries going in the forward direction have an angular distribution $\sim\cos^3\theta$, while those in the backward direction from nuclear interactions occurring in the chamber have a uniform distribution. (auth)

1994 Investigation of the Relationship Between Heavy Particles and "Special" Showers in Cosmic Rays. A. N. Gorbunov and I. V. Chuvilo. Doklady Akad. Nauk S.S.S. R. 69, 333-5(1949)(in Russian).

So-called "special" showers, produced in matter by cosmic rays and containing high-energy "nucleo - active" particles that produce nuclear disintegrations, were studied with a double proportional counter (aluminum cylinder divided in two by an Al longitudinal partition) and three self-quenching counters arranged in various ways: all four counters together under Pb; the proportional counter separated from the others by a layer of Pb of varying thickness; all four counters together under Pb, the thickness of the Al partition varying. The analysis of the pulse coincidences recorded by the instrument showed that the pulses in the proportional counter were produced: (1) in 75% of all cases, by heavy particles and by nuclear disintegrations generated in the counter's walls by penetrating particles; (2) in 5 to 10% of cases, by heavy particles generated in the counter's walls by "nucleo-active" particles of the "special" showers; and (3) in 15 to 20% of cases, by dense showers of 25 and more particles per 100 cm².

1995 Mesons Produced by Neutrons from the Cyclotron. F. M. Smith, Eugene Gardner, and Hugh Bradner. Phys. Rev. 77, 562-64(1950) Feb. 15 (Letter to the editor).

The authors report preliminary results on stars containing meson tracks produced by particles from the 184-in. Berkeley cyclotron. The neutrons used for bombarding the plates are produced in the cyclotron when a beam of 345-Mev protons strikes an internal target. The target plates are placed in a position similar to that used in cloud-chamber studies of mesons produced by neutrons from the cyclotron (Hartsough et al, Phys. Rev. 75, 905(1949)). In a survey of 8 cm² of one plate which was exposed about 5 min at a distance of about 60 ft from the target, a total of five stars was found in which one of the outgoing particles was a meson.

PHYSICS

In addition there were four meson tracks which could not be followed back to their initial point. In the same plate 5×10^4 stars with no meson tracks were observed. These figures are to be interpreted with caution, because no attempt was made to estimate the mesons missed, and because the C2 emulsion used does not record mesons of energy greater than about 10 Mev.

1996 Multiple Production of Mesons. Phyllis Freier and E. P. Ney. Phys. Rev. 77, 337-41(1950) Feb. 1.

Cloud-chamber photographs and photographic emulsion events have been obtained which are interpreted in terms of multiple meson production. In some cases it can be shown by charge conservation and penetration of lead that a large number of the particles in hard showers are not nucleons or electrons. The results are compared with the predictions of Heisenberg and Leprince-Ringuet (Heisenberg, Nature 164, 67(1949); Peyrou et al, Compt. rend. 228, 1777(1949)). By comparing the interactions in C and Pb one is led to the conclusion that mesons are made at 55° geomagnetic latitude with an average multiplicity of about five by protons of average energy about 8 Bev. (auth)

1997 Nuclear Disintegrations and Showers of Electrons and Nuclei in Cosmic Rays. A. N. Gorbunov. Zhur. Eksptl. i Teoret. Fiz. 19, 1076-97(1949)(in Russian). (See also NSA 1-1565.)

This is a description of experiments made by the author in the Pamir mountains in the years 1946 to 1949. Using a double proportional counter (aluminum cylinder with a longitudinal 50 μ Al partition), a study was made of the products of nuclear disintegrations due to cosmic rays, and of the relationship between the generating particles and both narrow showers and showers composed of electrons and nuclei. Absorption coefficients of penetrating generating particles in air and in several dense filters were measured. (auth)

1998 On the Applicability of Poisson's Law to the Spacial Distribution of Particles and on the Density Spectrum of Extensive Atmospheric Showers. M. I. Podgoretskiĭ, I. L. Rozental, and S. A. Slavatinskiĭ. Zhur. Eksptl. i Teoret. Fiz. 19, 1141-6(1949)(in Russian).

The interpretation of observations on extensive atmospheric showers is usually done on the assumption that the distribution of the shower particles is described by Poisson's law. A qualitative theoretical examination of the question by Podgoretskiĭ (Doklady Akad. Nauk S.S.S.R. 68, 23(1949)) showed that, in view of the genetical relationship between particles, no strict realization of Poisson's distribution is possible; however, the deviations decrease with decreasing dimensions of the recording set-up. In the present paper an experimental verification of the foregoing conclusions is described, the method employed involving, in principle, the use of two groups of M counters; if n_1 and n_2 are the numbers of counters in each group recording a shower, and $\bar{n}_1$ and $\bar{n}_2$ are the corresponding arithmetical means from observations, the following equation is true, provided the Poisson law is obeyed: $\overline{n_1^2} = (1 - 1/M)\,\overline{n_1 n_2} + \bar{n}_1$. The results showed that the spacial distribution of particles in extensive atmospheric showers of average densities is represented, in the first approximation, by Poisson's law. The paper

PHYSICS

describes also measurements of the density spectrum of extensive showers, which were made by using the method of anti-coincidences.

1999 On the Artificial Production of Mesons. Guido Beck. Anales soc. cient. argentina 147, 263-81 (1949)(in Spanish).

An elementary exposition of the recent experimental work on the meson, especially that of Lattes and collaborators, is given.

2000 On the Energy Spectrum of Heavy Nuclei in Primary Cosmic Radiation. M. S. Vallarta. Phys. Rev. 77, 419-20(1950) Feb. 1 (Letter to the editor).

Bradt and Peters (private communication) have obtained recently the intensity of heavy nuclei in primary cosmic radiation reaching the earth at 55 and 30 deg north geomagnetic latitudes. On the basis of the results of this investigation the author estimates the value of the constant in the energy spectrum of heavy nuclei, assumed to be of the form K/E^{γ}, using for this purpose the geomagnetic latitude effect for particles arriving essentially in the vertical direction. The principle of this analysis has already been outlined (Vallarta et al, Phys. Rev. 71, 393(1947)). The values of this constant, as well as the cut-off energies for the aforementioned latitudes, are tabulated for six atomic numbers ranging from 2 to 20. The average value of γ is 1.54 and the value does not vary significantly over the range of atomic numbers covered. The results are only a first approximation and are subject to revision.

2001 On the Measurement of the Mass of Charged Particles by Grain Counting in Sensitive Emulsions. Lud van Rossum. J. phys. radium 10, 402-11(1949) Dec. (in French).

The mass of the π meson was determined by two different methods. Measurements of the radii of curvature of meson trajectories in magnetic fields and of residual range in photographic plates were combined to give the following result:

$$m_{\pi} = \left(280 \begin{Bmatrix} +15 \\ -5 \end{Bmatrix} \pm 600 \frac{\Delta H}{H}\right) m_e$$

where H is the magnetic field strength and ΔH is the variation of the field strength over the meson trajectory. Comparisons of the grain distribution in meson tracks with the grain distribution in the tracks of particles of known mass gave the result $m_{\pi} = (280 \pm 15(m_e$. No mesons were found with smaller mass, but questionable examples of mesons with higher mass were noted. In conclusion the author discusses π-meson decay and capture, and gives an empirical relation between the grain density and the rate of energy loss for the observed meson tracks.

2002 On the Solar Origin of Cosmic Radiation. II. H. Alfvén. Phys. Rev. 77, 375-9(1950) Feb. 1. (See also NSA 2-1564, 3-741.)

Teller-Richtmyer's theory of the origin of cosmic radiation is discussed. It is found that the magnetic field ("trapping field"), which they postulate in order to explain the isotropy of cosmic radiation, must be toroidal and have an extension of about 0.01 light year. A field of this type may be produced by the motion of the solar system relative to interstellar matter. The theory gives the energy spectrum and total intensity of cosmic radiation. (auth)

2003 On Some Low Ionizing Radiation Observed by Measurements of Cosmic Radiation at Great Depths. M. Miesowicz, L. Jurkiewicz, and J. M. Massalski. Phys. Rev. 77, 380-3(1950) Feb. 1.

By measurements of twofold, threefold, and fourfold coincidences with a Geiger counter telescope, the underground rays at 660 and 540 m water equivalent have been divided into two components. One of the components is ionizing, discharging the counters with almost 100% efficiency, and has a strong maximum in the vertical direction. The other component discharges the counters with a very low efficiency, producing numerous twofold coincidences but practically no threefold or fourfold coincidences. It is isotropic in direction and rapidly absorbed in lead. This second component is thought to be composed of γ rays of local radioactive origin. The telescope used in these experiments differed from that of Barnóthy and Forró in that it was protected from side showers by anticoincidence counters. The ratio of twofold to threefold coincidences was found to be about 1.4 instead of 20 as reported by Barnóthy and Forró at 1000 m water equivalent (Phys. Rev. 55, 870(1939)). (auth)

2004 The Origin of Cosmic Rays. Ya. P. Terletskiĭ. Zhur. Eksptl. i Teoret. Fiz. 19, 1059-75(1949)(in Russian).

Recent experimental and theoretical investigations confirm the author's hypothesis of the generation of the primary cosmic rays in electric fields induced by magnetic fields that belong to cosmic bodies (Zhur. Eksptl. i Teoret. Fiz. 18, 479(1948)). In the light of an analysis of trajectories of electric charges in electromagnetic fields of cosmic objects, various possible types of "cosmic accelerators" are examined. Fermi (Phys. Rev. 75, 1169(1949)) attributes the principal part in the accelerating of primaries to the chaotically moving rarefied cosmic clouds that, in view of their high conductivity, must be considered as magnetized; Richtmyer and Teller (Phys. Rev. 75, 1729(1949)), and Alfven (Phys. Rev. 75, 1732(1949)) see in the magnetic field of the sun the source of the vortex electric fields that generate the cosmic radiation; Swann (Phys. Rev. 43, 217(1933)) has shown that sun spots may act as particle accelerators. The author prefers a theory involving all the magnetized stars of the Galaxy, the general expression of the electric field of a revolving cosmic dipole being a sum of three terms: one term is due to variations of the absolute value of the magnetic moment; another, to unipolar induction; and the third term corresponds to the rotation of the component of the magnetic moment which is perpendicular to the star's rotation axis.

2005 Production of High-Energy Electrons and Photons by Cosmic Radiations in Deep Atmospheric Layers. G. Ya. Artyukhov, G. T. Zatsepin, L. I. Sarycheva, and L. Kh. Eĭdus. Doklady Akad. Nauk S.S.S.R. 68, 465-8(1949)(in Russian).

High-energy electron-photon component of cosmic rays was observed at altitudes from 2,200 to 4,700 m with the aid of a counter group under 3-3.5 cm Pb. The absorption coefficient found corresponds to $1/\mu = 124 \pm 12$ g/cm^2,

PHYSICS

whereas, by assuming this component to be a descendant of high-energy electrons born in upper layers of the atmosphere, the cascade theory would give $1/\mu = 70$ g/cm^2. Since the former value coincides with that which characterizes particles capable of producing "special" showers by nuclear collisions in thick layers of matter, a genetically-determined equilibrium proportion between the two components (high-energy electron-photon component and that which produces nuclear explosions), is proved. Measurements of the density of accompanying particle streams in the atmosphere showed that the mean energy of the electrons under study increases with altitude; however, the effect of this relationship on the foregoing finding is small. Zatsepin's hypothesis (Doklady Akad. Nauk S.S.S.R. 67, No. 6(1949)), postulating secondary high-energy explosion-producing particles that multiply in air and are correlated with extensive showers, is thus found to account for the generation of the high-energy electron-photon component in lower layers of the atmosphere.

2006 Report on the More Recent Work on Penetrating Showers and Penetrating Particles. Kurt Sitte. Acta Phys. Aust. 3, 198-228(1949)(in German).

The first section of this article describes the experiments which led to the identification of penetrating showers as a special class of showers. The second section contains a presentation of the counter experiments of Janossy, Rochester et al, which led to an explanation of the nature and origin of the penetrating particles. Section three describes the cloud chamber experiments of Rochester, which not only substantiated the results of the aforementioned counter experiments, but also indicated the existence of two new, unstable, elementary particles of approximately 1,000 electron masses. More recent experiments by Janossy and Broadbent are treated in section four. These lead to the hypothesis that a light particle of 3 to 5 electron masses appears in penetrating showers. Sections five and six are devoted to a further discussion of the experimental results relevant to the problem of determining the existence of light and heavy components in the penetrating showers.

2007 Showers of Electrons and Nuclei in Cosmic Rays and the Nuclear-Cascade Process. N. G. Birger, V. I. Veksler, N. A. Dobrotin, G. T. Zatsepin, L. V. Kurnosova, A. L. Lubimov, I. L. Rozental, and L. Kh. El'dus. Zhur. Eksptl. i Teoret. Fiz. 19, 826-50 (1949)(in Russian).

A summary is presented of the work done by Russian investigators during the last few years, establishing the fundamental part played by penetrating particles in the cosmic radiation. The extensive atmospheric shower is described as being intimately correlated with the so-called "electron-nuclear" showers consisting of (1) high-energy particles producing nuclear disintegrations that give birth to new high-energy particles, the process being a cascade-like multiplication, (2) electrons and photons generated during the above process and multiplying cascade-fashion, (3) the usual star-producing particles, (4) strongly-ionizing particles and neutrons, and (5) μ-mesons. These views permit a consistent interpretation of a number of known facts. Almost all of the 23 references are Russian.

2008 Solar Flares and the Origin of Cosmic Radiation. I and II. J. Clay, H. F. Jongen, and A. J. Dijker. Proc. Koninkl. Nederland. Akad. Wetenschap. 52, 899-914(1949).

On July 25, 1946 a considerable increase of cosmic radiation was measured by observers (Forbush et al, Revs. Modern Phys. 21, 44(1949); Dolbear and Elliot Nature 159, 59 (1947)). This increase was also observed in Amsterdam, where cosmic ray intensities have been measured continuously for the past 15 years with the aid of ionization vessels filled with argon. Records of cosmic ray intensity for July 25 and 26 were examined, and variations were correlated with the activity of solar flares. This work led to further investigations of cosmic ray intensities during 1947, a year of great solar activity, and many other cosmic ray maxima were found, all of which could be traced to solar flares, with a delay of 0-2 hr. A day by day record of these variations is given. The author concludes that these cosmic ray variations cannot be caused by variations in the magnetic field of the sun, if the magnetic moment of the sun is of the order of 10^3 Gauss cm^3, the generally accepted value. He also believes that Fermi's theory (Phys. Rev. 75, 1169(1949)) that cosmic ray particles are accelerated by the magnetic fields of dust clouds.

2009 Solar Flares and the Origin of Cosmic Radiation. III. J. Clay, H. F. Jongen, and A. J. Dijker. Proc. Koninkl. Nederland. Akad. Wetenschap. 52, 923-6 (1949).

After the appearance of articles I and II in this series, a paper by Ehmert (Z. Naturforch. Bd. 3a, 264(1948)) was published citing 28 cases of increases in cosmic ray intensity in the period 1941-1943. In four of these cases, correlations with chromospheric eruptions were noted. In examining records of past cosmic ray activity, the authors noted an increase in activity on March 7, 1942, corroborating Ehmert's report of increased intensity on that day. Analyzing the ionization produced in different ionization vessels with different shielding, the authors conclude that the ratio of the components of various energies changed during the increase of activity, and that this is true in most cases which may be correlated with solar flares. It also appears that most of the increases in cosmic ray intensity occur during May, June, and July, and that this effect is so marked that it cannot be attributed to coincidence.

2010 Zenith Angle Dependence of Extensive Air Showers. H. L. Kraybill. Phys. Rev. 77, 410-11(1950) Feb. 1 (Letter to the editor).

On the basis of certain assumptions as to the behavior of air showers, the author has derived a relation between the number of air showers per steradian at a given altitude and zenith angle, and the observed counting rate as a function of the altitude. Using experimental values of this counting rate function, obtained by the author (Phys. Rev. 76, 1092(1949)), one obtains a zenith angle dependence for the axes of the air shower which can be approximately represented by $\cos^5\theta$ between 0 and 45 deg but which decreases more rapidly than $\cos^5\theta$ at larger zenith angles. An experimental test of this distribution was attempted at Climax, using the directional sensitivity of long cylindrical counters to define the zenith angle. The horizontal to vertical counting ratio was calculated using various angular dependences and the experimental ratio seems to fit a $\cos^4\theta$ dependence. The cause of this discrepancy between theory and experiment is unknown.

PHYSICS

2011 A Horizontal High Vacuum Electrical Resistance Furnace. W. E. Kuhn and O. W. Ellis. Can. J. Research 28F, 1-20(1950) Jan.

A high temperature vacuum furnace is described which has been in almost continuous use during the past four years in the production of powders of sintered compacts of titanium and titanium alloys. Although vacuum furnaces are technologically applicable to industry, economically they are applied only where other alternatives do not present themselves. This is mainly due to the present high cost of installation and operation. The main contributory factor to high cost, particularly with large furnaces, is degassing refractories. The problem is to reduce the amount of refractories which degas to a minimum. Two methods of doing this are discussed: one employs heat resistant alloy or metal within an insulated heated chamber; the other employs a refractory heater surrounded by an insulated radiation shield to protect the inner side of the insulated furnace wall. The furnace described was built to the latter design.

2012 Quick Locking Furnace Base Plate. Robert J. Anicetti (to U.S. Atomic Energy Commission). U.S. Patent 2,431,905, Dec. 2, 1947.

A bottom closure for quick assembly and disassembly of furnaces and crucibles is described. This comprises a plate adapted to fit in raceways secured to the lower ends of a cylindrical wall member. The furnace includes, in combination, a cylindrical wall, an annular flange secured to an end of the wall, a plurality of depending raceways fastened at spaced intervals around the outer periphery of the annular flange, an inclined slot extending from a side of each of said raceways, a disk shaped closure member, an annular groove in the member, and a deformable gasket carried in the groove adapted to engage the annular flange. Also described is a furnace having, in combination, a double cylindrical wall adapted to contain a fluid coolant between them, an annular flange secured to an end of the double wall and forming a fluid tight joint with it.

2013 On the Isotopes of Carbon. M. Paul. Ann. pharm. franc. 7, 673-88(1949) Nov. (in French).

After a brief description of the operation of the mass spectrograph, and of the role that this instrument has played in the identification and separation of isotopes, the author describes the two stable isotopes of carbon (carbon 12 and 13). These isotopes may also be separated, on a larger scale, by thermal diffusion and other methods. It is noted that C^{13} is much more abundant in minerals and rocks than in vegetable matter. The production and the properties of the radioisotopes are also discussed. The use of tracer methods in biology and physiology is outlined and, as an example, the author describes tracer studies of photosynthesis with C^{11} and C^{14} and studies of digestion and metabolism carried out with C^{14}.

2014 The Electromagnetic Concentration of Be^{10}. C. P. Keim, H. W. Savage, and Boyd Weaver. Phys. Rev. 77, 414(1950) Feb. 1 (Letter to the editor).

Be^{10} present as a small fraction in Be^{9} irradiated in the pile has been successfully enriched by the electromagnetic process. The weak specific activities in the beryllium charge material used in the electromagnetic separation indicated that the Be^{10} was present to the extent of about one part in 500,000. After the Be^{10} was enriched in the calutron, the specific activity of the enriched Be^{10} showed that it had been given an enrichment factor of 870 and 1200 in the two samples processed. A few milligrams of enriched beryllium were obtained in the separations.

2015 Investigation of Various Methods of Separating Lithium Isotopes. E. Yatabe and D. F. Stedman. National Research Laboratories (Canada) Report No. C-69-48S, Oct. 26, 1948. 26p.

The purpose of this investigation has been to make a preliminary study of various methods of separating Li^7 and Li^6 in order to suggest a program for further research. The primary objective is to increase the concentration of Li^7 in metallic lithium to 99.95% or better. The methods of separation of the isotopes have been considered from the standpoint of possible production in large quantities. Such being the case, some of the methods which give clean separation in milligram quantities but not adaptable to large scale production have been rejected. After considerable investigation of the published literature on the general principles and methods of isotope separations and of the physical and chemical properties of lithium and its compounds, several methods were considered most suitable for the successful separation of Li^6 and Li^7. Some of these methods have been tried experimentally by various investigators, while the others have yet to be attempted. These methods are listed as follows: (1) distillation of lithium and its compounds, (2) liquid phase partition coefficients of lithium and its compounds, (3) chromatographic methods, (4) electromigration methods, (5) combined chromatographic and electro-migration methods. A discussion of each method is included. 66 references.

2016 Mass Spectrometry. Harold W. Washburn (to Consolidated Engineering Corporation, Pasadena, Calif.). U. S. Patent 2,475,653, July 12, 1949.

It is claimed that improved results are obtained with a mass spectrometer if the pusher electrode is, in effect, eliminated so that there is no substantial potential behind the zone of electron bombardment in which the ions are formed. Instead the potential is applied to the ions immediately after they diffuse from the region of their formation.

2017 Meeting of the German Physical Society of Hessen Held at Frankfort on Main on June 11, 1949. Angew. Chem. 61, 487-93(1949) Dec. (in German)

Among the papers presented was The Influence of Stray Fields on Mass Spectrometers, W. Ploch and W. Walcher.

2018 Meeting of the Society of Public Analysts, Held on November 29, 1949, at London. Chemistry and Industry, No. 3 (1950) Jan. 21.

At the 23rd meeting of the Physical Methods Group of the Society, the following paper was presented: The Mass Spectrometer: A Survey of Its Applications in Analysis, J. G. A. Griffiths.

2019 Calibration of Weston and Ansco-Sweet Density Standards. Patricia J. Harris. Naval Radiological Defense Laboratory Report No. AD-169(O), Oct. 10, 1949. 13p.

PHYSICS

A discrepancy was found to exist between the density standards of the Ansco-Sweet Model 11 and the Weston Model 887, two densitometers which the Navy has adopted for use in its film badge dosimetry program. To determine which of the two wedges was more suitable for a standard, both were calibrated according to a modified contact printing method for the absolute determination of diffuse transmission density as described in the ASA paper Z38.2.5.—1946. It was found that the Ansco wedge read consistently with the standard values while the Weston wedge read as much as 6% low for an experimental range of densities from zero to 1.84. (auth)

2020 A Simplified Geiger-Mueller Counter Circuit. H. D. LeVine. NYO-103, Jan. 5, 1950. 11p.

This report describes a Geiger-Mueller counter circuit suitable for construction by high school and college students and designed so that it may be fabricated from commercially available parts. This instrument was designed to fill the need for a simple circuit, free of high-voltage hazard, that will provide readings at radioactivity levels sufficiently low to result in no danger to users.

2021 The Blackening Effect of Neutron and Gamma Radiation on DuPont 552 and Eastman V-120 Film. Ben Kalmon. ORNL-394, Nov. 16, 1949. 26p.

The blackening of DuPont 552 film and Eastman Kodak type V-120 film due to γ and neutron radiation has been investigated. In the case of the DuPont 552 film, 1 curie of an unfiltered Po-Be neutron source, at 1 cm, would produce blackening equivalent to 504.4 mr/hr of unfiltered radium γ radiation. For filtered neutron and γ radiation, the equivalent blackening was 236.8 mr/hr. For Eastman V-120 film, the equivalent blackening was 472.1 mr/hr for unfiltered radiation. No detectable blackening was observed with V-120 film when exposed to a 2-in. lead filtered Po-Be neutron source on exposures up to 3.75×10^8 neutrons/cm^2. A portion of each film was surrounded with $\frac{1}{16}$-in. lead sheet. For both neutron and γ radiation it was observed that, in general, the lead sheet acted as an intensifying screen. The exceptions were with the 552 film exposed to the unfiltered γ source and for the V-120 film exposed to the unfiltered γ source. In the case of the 552 film, the blackening was less, and for the V-120 film the blackening was the same behind the lead sheet. (auth)

2022 A Simple Low Drift Electrometer. F. M. Glass. ORNL-486, Dec. 30, 1949. 17p.

The increased demand for means of measuring very small currents and potentials has brought about the development of many electronic instruments for this purpose. Some of these instruments are no more than simple vacuum tube voltmeters designed around the recently developed electrometer tubes. This paper discusses the design principles and construction details for one model of this type, featuring a-c operation, compactness, low drift, moderate sensitivity, ruggedness, and low cost. (auth)

2023 The Effect of High Energy Radiation on the Optical and Electrical Properties of Alkali Halides. R. M. Lichtenstein. General Engineering and Consulting Laboratory, 1949. 32p. (NP-1374.)

It has been known that high energy radiation, e.g., γ and x-radiation will color alkali halide crystals, and that light will bleach the crystals again. It has also been observed that a current will flow during the bleaching process if a voltage is applied to the crystal (R. W. Pohl, Proc. Phys. Soc. 49, 3(1937); F. Seitz, Rev. Mod. Phys. 18, 384(1946)). This paper examines the phenomena in connection with their use for radiation detection. Favorable characteristics found for alkali halide crystals are simplicity and ruggedness, small size, extremely wide range, sufficient sensitivity for health protection service, good proportionality between dosage and indication, and sufficient permanence of activation. Unfavorable characteristics are as follows: the sensitivity varies from crystal to crystal; the calibration depends on the wavelength of the activating radiation; in potassium crystals, owing to the presence of the radioactive potassium isotope, there occurs self-activation at the rate of 6 mr per day; there exists some residual photoconductivity which covers up dosages below ¼ mr.

2024 Electron Multiplier Cells. Developments. Use. André Lallemand. J. Phys. Radium 10, 235-9 (1949) July, Aug., Sept. (in French).

The author gives a theoretical treatment of the fluctuations in the output current of electron multiplier cells as a function of the number of stages and the multiplication factor per stage. Other causes of fluctuation are discussed and a cell was so constructed as to minimize the fluctuations in output. The results obtained with this cell are described. The author then analyzes several specific problems pertaining to the use of electron multipliers, such as the design of high voltage power supplies and the determination of the multiplication factor which is necessary when the multiplier is being used in conjunction with a galvanometer or amplifier. An especially stable symmetric amplifier has been designed for use with multiplier tubes. A neon bulb may also be used in a relaxation type of circuit to give an indication of the counting rate of the multiplier.

2025 Focusing in a Semicircular Magnetic Spectrometer. C. M. Fowler, R. G. Shreffler, and J. M. Cork. Rev. Sci. Instruments 20, 966-7(1949) Dec. (Laboratory and shop note).

This paper presents a graphic derivation of the line shape produced by a semicircular magnetic spectrometer, assuming a two-dimensional source and two-dimensional defining slits. The theoretical line shapes are plotted for various focusing radii, slit, and source widths.

2026 Geiger Counter. Ladislas Goldstein (to International Standard Electric Corp., New York). U. S. Patent 2,485,586, Oct. 25, 1949.

A light-weight Geiger counter is described which is characterized by such high sensitivity that additional amplifiers can be dispensed with. The principle of operation is the following: When the gas in the counter is ionized, and potentials are applied between the anodes and cathodes, pulses of current are produced in the associated circuit, and photons are emitted. The pulses in the circuit associated with the anode and cathode are not measured, but the photon emission is.

2027 Geiger Counter Structure. Herbert Friedman. U. S. Patent 2,475,603, July 12, 1949.

This invention comprises a Geiger-Mueller counter which departs from the conventional cylindrical cathode and

PHYSICS

coaxial anode wire in the provision of a cathode structure which bears the normal geometric relationship to the anode wire but is of such construction that it maintains an electric field in the anode counting region to provide for the counting action of the tube, and by the cathode structure reduces the background count of the tube practically to the vanishing point.

2028 An Intermediate Image β-Spectrometer of High Transmission. Hilding Slatis and Kai Siegbahn. Arkiv Fysik 1, 339-57(1949).

The focusing properties of a lens spectrometer as a function of the magnetic field gradient were investigated by two methods. The first, conventional, methods involved Geiger Mueller counting technique. The other is a photographic electron path tracing method using the F-line of ThB as a monoenergetic electron source. A new type of lens focusing was observed when the magnetic gradient was sufficiently strong, giving an exceptionally high intensity with good resolving power. Thus, at a resolving power of 4%, about 8% of the total radiation was transmitted. The focusing principle was investigated in some detail. The paths of the different electron beams were constructed by means of the photographic method. It was found that an intermediate ring-shaped image is first formed. A second, point image is then focused at the slit of a conventional small Geiger Mueller counter. The adjustments of the different parameters of the spectrometer are discussed. It is important that the field gradient and the position of the sample are exactly adjusted. (auth)

2029 Long-Lived Self-Quenching Counter Filling. Lloyd G. Shore. Rev. Sci. Instruments 20, 956-7(1949) Dec. (Laboratory and shop note).

It has been found that counters filled with a suitably proportioned mixture of the four gases argon-xenon-oxygen-nitrogen are self-quenching when operated with the same counter circuits ordinarily used with conventional self-quenching counters. Such counters may have long, flat plateaus, operate at reasonable voltages and furthermore, they may show no change in plateau characteristics after prolonged operation at high counting rates. A plot is given of the variation of the plateau width and threshold voltages as a function of the partial pressures of the various constituents of the filling. One such counter has been in continuous operation for several weeks at approximately 10^8 counts/day, without showing any deterioration effects.

2030 Multigrid Ionization Chamber. Robert Earl Fearson (to Well Surveys Inc., Tulsa, Okla.). U. S. Patent 2,480,808, Aug. 30, 1949.

This invention consists of an ionization chamber, in which two or more concentric grids surround the inner electrode. By maintaining these grids at the proper potentials, and by applying the proper combined a-c and d-c potential across the electrodes, pulses indicating very exactly the intensity of ionizing radiation in the chamber are produced.

2031 Note on the Detection of Coincidences and Short Time Intervals. Robert Hofstadter and John A. McIntyre. Rev. Sci. Instruments 21, 52-3(1950) Jan.

PHYSICS

A flexible method of detecting coincidences and short time intervals has been devised in which a photomultiplier tube views the screen of a cathode-ray tube. By using one pulse as initiator of a sweep and the other in vertical presentation, coincidences can be observed in a fixed portion of the screen while the remainder of the screen is masked off. In present use the method is limited only by the pulses available (5×10^{-8} sec). The method appears to be capable of extension to time intervals of the order of 9×10^{-10} sec or smaller. (auth)

2032 Note on Sealing Nylon Films to Geiger Counters. Robert A. Becker. Rev. Sci. Instruments 20, 966 (1949) Dec. (Shop notes).

This article describes a method of attaching a thin nylon sheet as the end window of a Geiger counter. The seal is of the compression type, and the bonding material is ordinary rubber cement, diluted with several parts of benzene so that it is thin enough to spread uniformly. In order to minimize the effects of diffusion of the counter gas through the nylon, the counter may be kept open to a larger ballast volume and to a reservoir containing absolute alcohol.

2033 Particle Counters. Roland Maze. Atomes 45, 407-10(1949) Dec.(in French).

The author outlines, in nontechnical terms, the function of particle counters in nuclear research, then describes the construction and operation of the Geiger counter and the various types of associated circuits. He discusses the modifications necessary in counter design in order to allow the counter to discriminate between different types of particles. The concluding section of the article is devoted to a brief treatment of proportional counters and scientillation counters.

2034 Practical Radium Dosimetry by Means of Very Small Ionization Chambers. Part II. H. A. Bomke and H. Eberle. Strahlentherapie 78, 417-28(1949) (in German).

A discussion is given of the difficulties which arise in the measurement of very weak ionization currents by means of small ionization chambers. A detailed consideration shows that by using a tube with a floating grid as a sensitive null balance in connection with an arrangement to compensate the current to be measured by equal and opposite induced charges, one can construct an instrument as sensitive as those in common use but much safer to operate and requiring a much shorter time for measurements. The authors built such an instrument which satisfied the practical demands of radium dosimetry as outlined in Part I of this article (Ries, Strahlentherapie 78, 411(1949)).

2035 A Precise Method of Determining the Faraday by Magnetic Resonance. J. A. Hipple, H. Sommer, and H. A. Thomas. Phys. Rev. 76, 1877-8(1949) Dec. 15 (Letter to the editor).

A method of determining the Faraday has been developed in which the cyclotron resonance frequency of protons in a known magnetic field is measured. Ions, formed by electron impact, are accelerated by an r-f voltage of adjustable frequency until their orbits attain a radius of 1.0 cm, at which time they strike a collector and the beam current is measured. As the frequency is varied, the beam current

intensity shows a narrow peak at a frequency depending on the ratio e/m. The peak width is determined by the uniformity of the field and by the amplitude of the r-f. The magnet is the same one used for the measurement of the gyromagnetic ratio of the proton, and the ratio e/m may be calculated from the gyromagnetic ratio and the nuclear and cyclotron resonance frequencies. The same method may be used to measure the ratio of the proton and electron masses, and for the measurement of packing fractions.

2036 The Response of the Anthracene Scintillation Counter to Monoenergetic Electrons. John I. Hopkins. Phys. Rev. 77, 406-7(1950) Feb. 1 (Letter to the editor).

An anthracene scintillation counter was bombarded with monoenergetic electrons of various energies in order to determine the relation between pulse height and particle energy. A Cs^{137} electron source was used and the monoenergetic beam was produced by a 180-cm single lens β spectrometer. A plot of pulse height against electron energy is given, and it is noted that there is a slight deviation from linearity below 125 kev. Corrections were made for energy losses in various parts of the counting apparatus. Further work is being done to investigate the pulse height variation in the low energy range, and in the range above 650 kev.

2037 Statistics of Counting Rate Meters. Ronald E. Burgess. Rev. Sci. Instruments 20, 964-5(1949) Dec. (Laboratory and shop note).

The indication of a counting rate meter exhibits statistical fluctuations due to the random arrival of the particles or events being counted. These fluctuations determine the standard deviation of a single reading and set a limit to the accuracy of the instrument. They may be reduced by the process of smoothing which can be effected by taking the mean of any number of uniformly spaced readings or by averaging the reading continuously over a length of time. It is noted that the analysis given by Shiff and Evans (Rev. Sci. Instruments 7, 456(1936)) of the reduction of fluctuations by smoothing gave incorrect results because of an incorrect method of approach. This analysis is repeated and an expression is derived for the standard deviation of n counting rate readings spaced at uniform intervals.

2038 Study of the Deterioration of Methane-Filled Geiger-Mueller Counters with External Cathodes. Daniel Blanc. J. phys. radium 10, 411-14(1949) Dec. (in French).

The author has studied the changes in the characteristics of methane-filled Geiger counters with external graphite cathodes, as a function of the total number of counts. He used the type of counter originated by Maze (J. phys. radium 7, 164(1946)) modified in such a manner as to give the counter a well-defined effective length, so as to permit the study of the independent action of two neighboring sections of the counter cylinder. The useful life varies from 6.10^7 to 2.10^8 counts. The counting rate corresponding to a fixed overvoltage increases steadily, the threshold rises from 100 to 200 v, the plateau becomes shorter, its slope increases, but a plateau still exists after the deterioration of the counter. These changes are attributed to deposits on the inner surface of the cylinder. The observed phenomena are similar to those which follow a continuous discharge in the counter. (auth)

2039 Temperature Effects in the Spurious Discharge Mechanism of Parallel Plate Counters. Frank L. Hereford. Phys. Rev. 77, 559-60(1950) Feb. 15 (Letter to the editor).

During the preparation and testing of a number of parallel plate counters for use in investigation of short time delay phenomena a marked dependence of counting rate upon temperature has been observed. The counters used consisted of copper plates 9 cm^2 in area, spaced 0.2 cm apart and mounted in glass envelopes. The variation of counting rate with recovery time is given at various temperatures from 24–75°C. The counting rate, for a given recovery time, is a decreasing function of the temperature. Possible mechanisms to explain this phenomenon are discussed. The author concludes that operation at temperatures from 60–70°C could appreciably enhance the usefulness of the parallel plate counter, allowing an increase in the maximum counting rate attainable without dead time losses.

2040 Fast Neutron Count-Rate Dosimetry. G. S. Hurst. ORNL-589, Feb. 17, 1950. 16p.

Calculations indicate that fast neutron doses can be measured by simply taking counting rates. The principle used is that of designing a proportional counter such that its sensitivity relates to energy as does the reciprocal of the flux required to produce a tolerance dose. Although the calculations apply specifically to the case where the neutrons have energies between 0.2 and 10 Mev, it is possible that the same principle may be used for higher energy spectra. (auth)

2041 Determination of Neutron Spectra by Density Measurements in Paraffin Blocks; Nuclear Shielding Studies. Leigh Secreast. M. I. T. Laboratory for Nuclear Science and Engineering, Technical Report No. 36, Dec. 30, 1949. 31p. (NP-1385.)

The need for a simple, yet accurate, means of determining the magnitude and energy distribution of the neutron flux in a laboratory due to the action of a neutron source has been pointed out. This paper reports experimental work consisting of setting up an array of paraffin blocks of various lengths in a neutron field and measuring the neutron density at the center of each block by means of an indium foil. Theoretical considerations of the data are presented and it is concluded that the proposed method of neutron monitoring will perhaps be practical for low energy neutrons if the following conditions are met: (1) the slabs must have lateral dimensions of the order of magnitude of 10.0 cm, and (2) the foils will have to be calibrated empirically using controlled-energy neutron sources.

2042 The Distribution of Thermal Neutrons in the Vicinity of the Edge of a Cadmium Foil. Dilschad T. Elbrus and K. Zuber. Helv. Phys. Acta 22, 600-3 (1949) July 1 (in German).

In order to study the diffusion of neutrons in paraffin, the authors arranged the following experiment: a Ra-Be neutron source was placed in the center of a paraffin cylinder

and a strip of gold foil was wrapped around the cylinder at the same height as the source. This gold foil was to act as a detector. A cadmium foil was then wrapped around the cylinder, but this covered only a part of the circumference of the cylinder, leaving a strip of gold foil uncovered. Part of the gold foil under the cadmium foil was shielded from the source by another strip of cadmium, so that it was exposed only to slow neutrons, and the whole arrangement was then placed into a hollowed-out paraffin block. The integrated activity of the gold foil was then determined by exposing a photographic plate to the gold foil activity for several days, and the density of the film is plotted against the distance from the edge of the cadmium. The darkening due to slow neutrons was also calculated and a plot is given.

2043 Methods and Applications of Neutron Diffraction. C. G. Shull and E. O. Wollan. Naturwissenschaften 36, 291-6(1949) (in German).

This article is an elaboration of a lecture given by Shull at the Symposium on the Solid State (Nov. 13, 1948, Brooklyn Polytechnic Institute). A comparison is made between neutron diffraction and the well known methods of x-ray and electron diffraction. Some of the newly developed procedures for neutrons are described and their utility illustrated by some applications in which crystallographic information was obtained which greatly exceeds that obtainable by x-ray investigations.

2044 Neutrons from $Li^7(p,n)Be^7$. V. R. Johnson, M. J. Wilson Laubenstein, and H. T. Richards. Phys. Rev. 77, 413-14(1950) Feb. 1 (Letter to the editor).

Experiments have been conducted with a view to detecting an excited state of Be^7. Thin targets of metallic lithium were bombarded by 3.34 and 3.96 Mev homogeneous protons from the Wisconsin electrostatic generator. Eastman NTA emulsions (glass backed) were mounted 15 cm from the target and at 0 and 60 deg to the proton beam. Plots are given for the distribution of the mean proton recoil energies, and two peaks are noted. These correspond to the ground state of Be^7 and to a level at 435 ± 15 kev. An estimate is given for the relative intensity of the low-energy neutron group.

2045 On the Fast Neutron Cross Section. B. H. Flowers. Atomic Energy Research Establishment Report No. AERE-T/R-451, Dec. 1949. 7p.

The theory of Feshback et al (Phys. Rev. 71, 145(1947)) is employed to derive relations between the fast neutron cross sections for heavy elements. From these relations it is possible to deduce the inelastic scattering cross section if the radiative capture cross section is sufficiently well known. The method is applied as an example to iodine. (auth)

2046 On the Theory of Slow Neutron Scattering by Liquid Helium. L. Goldstein, D. Sweeney, and M. Goldstein. Phys. Rev. 77, 319-29(1950) Feb. 1.

Using the extreme Bose-Einstein and Fermi-Dirac models of liquid He^4 and He^3, respectively, the theory of inelastic or incoherent slow neutron scattering by these liquids has been studied in this paper. The behavior of the scattering cross sections for various temperatures and degrees of degeneracy is described. Inverse scattering processes have also been studied using the principle of detailed balancing. It is noted that the large thermal neutron cross section for the reaction $n(He^3,p)H^3$ will complicate the eventual experimental investigation of the incoherent slow neutron scattering.

2047 Some Investigations with Fast Neutrons. Kenneth William Allen. pp. 121-122. Abstracts of Dissertations Approved for the Ph. D., M. Sc., and M. Litt. Degrees in the University of Cambridge, 1947-1948. Cambridge, University Press, 1949.

This dissertation is divided into two sections, both of which treat of investigations with fast neutrons. The first section deals with the measurement of fast neutron flux and energy, and describes the methods which have been developed in the Cavendish Laboratory during the period 1944-46. An accurate comparison is given of the methods that are described of measuring fast neutron flux, and an account is given of how the techniques that were developed were applied to the study of the neutrons produced by the disintegration of carbon and deuterium by deuterons. A value of -0.27 ± 0.01 Mev was found for the Q value of the $C^{12}(dn)N^{13}$ reaction, and the angular distribution of the neutrons was found to be isotropic in the center-of-gravity space for a deuteron bombarding energy of 930 kev. The angular distribution of the neutrons produced in the disintegration of deuterium by deuterons is also discussed. Recent developments in the design and operation of ionization chambers are discussed in so far as they affect the recording of fast neutrons, and the extension of existing techniques to the region of high energies is considered. In the second section the results of a study of the interaction of fast neutrons with beryllium and aluminum are reported. Resonance phenomena were observed in the scattering of neutrons by beryllium and aluminum and also in the (n,α) transmutation of beryllium. For beryllium, the resonance in both the scattering and (n,α) cross sections can be explained by a resonance level in the compound nucleus Be^{10} with an energy of 8.9 Mev above the ground state and with an orbital angular momentum probably greater than zero. Sharp resonances were also observed in the scattering of neutrons by aluminum, and a resonance level in the compound nucleus Al^{28} corresponding to a neutron bombarding energy of 2.9 Mev was found in addition to that at 2.4 Mev found by other workers. (auth)

2048 Thermal Neutron Distribution in a Slab of Paraffin. B. S. Smith. Nature 165, 196(1950) Feb. 4 (Letter to the editor).

In a recent note (Nature 163, 129(1949)) on the tolerance flux of thermal neutrons, P. Capron and others have described how they determined the distribution in a block of paraffin when thermal neutrons from a radium-beryllium howitzer source fall upon the free surface. Using this distribution, they then calculated the dose in soft tissue due to the γ rays emitted from the $H(n,\gamma)D$ reaction, in order to obtain the maximum tolerance flux of thermal neutrons. The authors concluded that the maximum flux of incident neutrons should be limited to 500 neutrons/cm^2/sec. It is possible to calculate the neutron distribution directly from the Boltzmann equation for the neutron flux. When this is done it is found that the theoretical curve does not agree with the experimentally determined neutron distribution as

reported by Capron. The author has repeated Capron's measurements using thermal neutrons from a pile and thin detectors of manganese foil. The distribution curve obtained in this way is in good agreement with the theoretical curve derived from the Boltzmann equation. The discrepancy between the two experimental curves is attributed to the thickness of the detectors used in Capron's experiment. The author believes that the thermal distribution in paraffin is so well known that no safety factor is necessary in calculating tolerances. He suggests a tolerance flux of about 1,250 cm^2/sec.

2049 A Contribution to the Problem of the Structure of the Atomic Nucleus: the Substructure N_8P_4. O. Monecke. Experientia 5, 440-1(1949) Nov. 15 (Brief note, in German).

From the observed distribution of the elements and their isotopes the author draws the conclusion that there exist stable subnuclei, consisting of eight neutrons and four protons, which play an important role in the structure of atomic nuclei.

2050 The 5-Ev Neutron Resonance in Ag. W. Selove. Phys. Rev. 77, 557(1950) Feb. 15 (Letter to the editor).

The 5-ev neutron resonance in Ag has been measured as follows: $\sigma_0\Gamma$ was determined from the "absorption integral" of a thin sample, and $\sigma_0\Gamma^2$ from the cross section far from resonance, σ_0 being the peak cross section and Γ the natural width. The "absorption integral," obtained by a transmission measurement, is defined as $\int(1-T)dE$ where T is the transmission of the sample and E the energy. Measured values were:

E (resonance) = (5.17 ± 0.08) ev
Γ = (0.17 ± 0.02) ev — uncorrected for Doppler effect
σ_0 = (12,000 ± 1500) barns — uncorrected for Doppler effect
(10,000 ± 1300) barns — corrected for Doppler effect.

It follows from these data and results of C. C. Muehlhause that the neutron width for the 5 ev resonance in Ag^{109} is 0.011 ev and the spin of the compound nucleus 1.

2051 Further Data on the Spin Gyromagnetic Ratio of the Electron. A. K. Mann and P. Kusch. Phys. Rev. 77, 435-8(1950) Feb. 15.

The atomic beam magnetic resonance method has been used to compare the g_J values of In in the $^2P_{3/2}$ and $^2P_{1/2}$ states in order to obtain a value of the spin gyromagnetic ratio of the electron. The determination of the g_J ratio involved only the measurement of frequencies of lines in the hyperfine spectra of both states at constant magnetic field. Lines with widely different frequency dependence on field were selected to avoid possible systematic errors arising from inhomogeneities in the field. The result of these measurements is $g_J(^2P_{3/2})/g_J(^2P_{1/2}) = 2(1.00200 \pm 0.00006)$. Assuming Russell-Saunders coupling, and $g_L = 1$, the spin gyromagnetic ratio of the electron may be calculated. The result is $g_s = 2(1.00133 \pm 0.00004)$, which is to be compared with the value $g_s = 2(1.00119 \pm 0.00005)$ obtained by Kusch and Foley (Phys. Rev. 74, 250(1948)). The discrepancy is greater than the sum of the experimental errors. The $^2P_{1/2}$ state of In is believed to be free of significant perturbations which might affect the total electronic g value. However, in view of possible perturbations of the $^2P_{1/2}$ state, the agreement must be considered as very good. The present result confirms the conclusions of the previous experiment, both as to the existence of the intrinsic magnetic moment of the electron, and as to its approximate magnitude. (auth)

2052 The Hyperfine Structure of the Stable Isotopes of Indium. A. K. Mann and P. Kusch. Phys. Rev. 77, 427-35(1950) Feb. 15.

The atomic beams magnetic resonance method has been applied to the study of the hyperfine spectra of the metastable $^2P_{3/2}$ state of both In^{113} and In^{115}. It has been found that the separations of the energy levels at zero external magnetic field are completely described by the equation $W = haC/2 + hbC(C+1)$, where $C = F(F+1) - I(I+1) - J(J+1)$, and a and b are the magnetic dipole and electric quadrupole interaction constants, respectively. No evidence has been found to indicate the existence of a nuclear moment of higher order than the quadrupole moment. These are the heaviest atoms in which a critical search for such moments has been made. The numerical values of the constants for In^{115} are:

$a^{115} = 242.165 \pm 0.002$ mc/sec
$b^{115} = 1.56098 \pm 0.00006$ mc/sec

The ratio a^{115}/a^{113} has been determined by Hardy and Millman (Phys. Rev. 61, 459(1942)) to be 1.00224 ± 0.00010. From this value, and the results of our measurements, the numerical values of the constants for In^{113} are:

$a^{113} = 241.624 \pm 0.024$ mc/sec
$b^{113} = 1.53855 \pm 0.00015$ mc/sec

where the uncertainties in a^{113} and b^{113} follow from the uncertainty in the ratio of the a's. The numerical values of the electric quadrupole moments are:

$Q^{115} = 1.161 \times 10^{-24}$ cm^2
$Q^{113} = 1.144 \times 10^{-24}$ cm^2

It is seen from the ratios $I^{115}/I^{113} = 1$, $a^{115}/a^{113} = 1.00224$, $b^{115}/b^{113} = 1.0146$, that in these measurable nuclear properties In^{115} and In^{113} exhibit the greatest degree of similarity observed for any pair of isotopes of odd mass differing in mass by two units. (auth)

2053 Note on Nuclear Models. Hoff Lu. Phys. Rev. 77, 416(1950) Feb. 1 (Letter to the editor).

A nuclear model is proposed in which the protonic charge is uniformly distributed over the surface of a sphere. On the basis of this model one may determine the value of the constant r_0 in the formula for the nuclear radius $r = r_0A^{1/3}$ in two different ways; it may be determined from the value of the coulomb energy in the semi-empirical mass law (Lapp and Andrews, Nuclear Radiation Physics. New York, Prentice-Hall, 1948, p. 146, Eqs. 7 and 8), or from the difference in coulomb energy of two contiguous isobars. If this second method is applied to the isobars N^{13} and C^{13} the value of r_0 so obtained is larger than the value calculated from the mass law. If, however, the extra proton in the N^{13} isobar is considered as localized on the surface of the

PHYSICS

sphere, the two results are brought into good agreement. This value ($r_0 = 1.23 \times 10^{-13}$ cm) is compared with the values obtained from radioactive decay and scattering data.

2054 The Nuclear Magnetic Moments of D^2, Li^7, and F^{19} Studied by the Magnetic Resonance Absorption Method. Kai Siegbahn and Gunnar Lindström. Arkiv Fysik 1, 193-212(1949).

A similar article appeared in Nature 163, 211(1949) Feb. 5 (letter to the editor). An abstract of the article is listed in Nuclear Science Abstracts as abstract No. 3-1140.

2055 Nuclear Paramagnetism. M. Soutif. J. phys. radium 10, 61 D-78 D(1949) Nov. (in French).

The theories of Lenz (Physik Z. 21, 613(1920)) and Langevin, as applied to electronic paramagnetism, are briefly summarized, and are used to study the behavior of paramagnetic substances in high frequency fields. The author then discusses the nuclear magnetic moment, describing qualitatively the atomic beam resonance experiments carried out by Rabi. This section is followed by a detailed description of nuclear induction and nuclear absorption methods for measuring gyromagnetic ratios, which may be applied to liquid and solid samples. In conclusion the author treats the quantum mechanical theory of these methods.

2056 Nuclear Quadrupole Hyperfine Structure in Slightly Asymmetric Rotor Molecules. Geoffrey Knight Jr. and B. T. Feld. M. I. T. Research Laboratory of Electronics Technical Report No. 123, June 10, 1949. 25p.

This report contains excerpts from the doctoral thesis of Geoffrey Knight, Jr., "Interaction of Nuclear Electric Quadrupole Moments with Molecular Rotation in Slightly Asymmetric Rotor Molecules." It is concerned with the theory for the interpretation of the hyperfine structure patterns of rotational transitions in slightly asymmetric rotor molecules. The approach has been to approximate the molecular wave functions in terms of symmetric rotor wave functions, and to derive explicit expressions for the quadrupole interaction in terms of the quantum numbers appropriate to the molecular states and of a single asymmetry parameter which measures the departure of the molecule from a symmetric top.

2057 Packing Fraction of Pt^{196}. Howard A. Johnson, Henry E. Duckworth, Richard S. Preston, and Richard F. Woodcock. Phys. Rev. 77, 424(1950) Feb. 1 (Abstract).

A double-focusing mass spectrometer has been used to obtain Pt^{196}-Zn^{66} doublets at mass number 66, by a method previously described (Woodcock et al, Phys. Rev. 77, 424 (1950)). This method involves photographing the doublet lines consecutively in order to adjust intensities. Assuming that the packing fraction of Zn^{66} is the mean of the values given by Dempster for Zn^{68} and Zn^{64}, the calculated value for Pt^{196} is $(+1.95)\times10^{-4}$. The brass which was used as a source of Zn ions also served as a source of Cu ions, creating a second doublet at mass number 65. The packing fraction difference Pt^{195}-Cu^{65} was found to be $(9.57 \pm 0.04)\times 10^{-4}$.

2058 Packing Fractions of W^{183} and W^{186}. Richard F. Woodcock, Henry E. Duckworth, Richard S. Preston, and Howard A. Johnson. Phys. Rev. 77, 424 (1950) Feb. 1 (Abstract).

A double-focusing mass spectrograph, which is a Dempster-type, has been used to measure the packing fraction differences (W^{183} – Ni^{61}) and (W^{186} – Ni^{62}). Triply-charged tungsten ions and singly-charged nickel ions, produced in a high frequency spark, formed the appropriate doublets at mass numbers 61 and 62. The measured values of these differences, combined with Shaw's recent value for the packing fractions of the Ni isotopes, give the following results for the packing fractions of W^{183} and W^{186}, respectively: $(+0.36 \pm 0.23)\times10^{-4}$ and $(+0.14 \pm 0.15)\times10^{-4}$.

2059 Spectroscopic Isotope Shift and Nuclear Polarization. G. Breit, G. B. Arfken, and W. W. Clendenin. Phys. Rev. 77, 569(1950) Feb. 15. (Letter to the editor).

Relative isotope displacements of spectroscopic terms of the heavier elements are known to be approximately explainable by the nuclear volume effect theory, but are also influenced to a certain extent by the polarizability of nuclei by electrons. The authors have made some calculations to determine the probable bearing of the expected polarizability on observation, making use of the non diagonal matrix elements, V, of the electrostatic energy of nuclear particles in the electrons field. The $|V|$ required for staggering are too large for a single proton central field nuclear model with monopole action; they come within range for α particles with non central field approximations to the nuclear wave functions. Interaction of $s_{1/2}$ electrons with the p continuum and of $p_{1/2}$ electrons with the s continuum through dipole action of an α particle is comparable with experimental indications. The polarization of the nucleus may perhaps be responsible also for the smallness of the observed shifts and some of the irregularities for even isotopes.

2060 The Spherical Shell Nuclear Model. H. A. Wilson Phys. Rev. 77, 516-20(1950) Feb. 15.

The spherical shell nuclear model proposed by the writer has vibration levels given by $E_n = \Delta E((n-1)(n+2))^{1/2}$ with $n = 2, 3, 4\ldots$ and $\Delta E = Ze/4\pi(Am)^{1/2}r^{3/2}$. Here Z is the atomic number, e the protonic charge, A the mass number, m the mass of a nucleon and r the nuclear radius. The values of E_n with $\Delta E = 0.387$ Mev are found to agree approximately with the excitation levels of many nuclei. With $\Delta E = 0.387$ Mev the radius r is given by $r = 4.65 \times 10^{-13}(Z^2/A)^{1/3}$. Besides the vibration levels rotation vibration levels given by

$$E_{nj} = 0.387((n-1)(n+2))^{1/2} + 1.44(Z^4A)^{-1/3}\, j(j+1)$$

have been found with several nuclei. The energy of the shell model is discussed and the shell is shown to be stable for uniform radial displacements. The level spacing at high excitations on the shell theory is much larger than on current theories. It is shown that the experimental evidence on level spacing can be explained on the shell theory. (auth)

2061 Engineering Aspects of Nuclear Reactors. II. L. A. Ohlinger. Nucleonics 6, 10-17(1950) Jan. (See also NSA 4-1537.)

PHYSICS

The author discusses the function and structure of neutron reflectors, the structure and composition of radiation shields to be used with piles, methods of cooling the pile with liquid or gaseous coolants, and methods of controlling the operating level of the reactor. The heat removed in the cooling process may be dissipated as waste or may be utilized for practical purposes. Existing installations are cited as examples.

2062 The Disintegration of Carbon by Deuterons. G. C. Phillips. Texas J. Sci. 1, 134-5(1949) Sept. 30.

A study was made of the nuclear reactions produced by the bombardment of C^{12} by deuterons. The following reactions were observed: $C^{12}(d,p)C^{13}$, and $C^{12}(d,n)N^{13}$. In the first case the C^{13} decays subsequently by γ emission, and in the second reaction the N^{13} decays by positron emission, and it was these secondary decay processes which were studied. Resonance energies and cross sections are given for both reactions, and the angular distribution of the neutrons produced in the second reaction was analyzed.

2063 A Note on the $Li^7(p,n)Be^7$ Reaction and an Excited State of Be^7. T. A. Hall. Phys. Rev. 77, 411-12 (1950) Feb. 1 (Letter to the editor).

The author has reexamined data obtained two years ago with a Van de Graaff generator, using the $Li^7(p,n)$ reaction as a source of monoenergetic neutrons to study the resonance scattering of neutrons on helium (Hall and Koontz, Phys. Rev. 72, 196(1947)). In this experiment the neutrons crossed a proportional counter containing helium, and the energy distribution of the helium recoils was recorded. The distribution curves should have been parabolas, corresponding to superposition of S and P wave scattering. Instead, well defined absorptions were observed. These are attributed to an excited state of Be^7, resulting in a di-energetic neutron beam. The excitation energy of this state is calculated to be 0.45 Mev. Other recent measurements also indicate the existence of such an excited state (Grosskreutz and Mather, Bull. Am. Phys. Soc. 24, No. 7, H5(A) (Chicago, 1949); Brown et al, ibid. 24, No. 8, D11(A) (Stanford, 1949)).

2064 The Photo-Disintegration of Nitrogen at Energies of 20 Mev to 100 Mev. E. R. Gaerttner and M. L. Yeater. Phys. Rev. 77, 570-1(1950) Feb. 15 (Letter to the editor).

Data are presented on about 5000 disintegrations in nitrogen, produced by x-rays from a 100 Mev betatron and observed in a cloud-chamber. The authors distinguish between "singles" (heavily ionizing tracks of short range, < 1 cm), " flags" (consisting of two charged members, one of which is short and heavily ionizing), and "stars" (with three to six charged members). The 10-min activity induced in thin copper samples placed in the x-ray beam was taken as monitor of the beam intensity. The results presented include the number of observed tracks per disintegration and the ratio "stars"/"flags" at energies from 20 to 100 Mev, and the number of flags, and the ratio (No. of "flags")/(copper activity) at 50 and 100 Mev.

2065 Preparation of Imponderable Quantities of Artificially-Radioactive Sulphur, $_{16}S^{35}$, from Carbon Tetrachloride. Otto Erbacher and Hilde von Laue-Lemcke. Z. anorg. Chem. 259, 249-54(1949) (In German).

Imponderable quantities of S^{35} (88 days) were obtained by irradiating CCl_4 with fast neutrons for several months. The formed sulfur, oxidized by dissolved air into sulfate ions, was extracted with a water solution of ammonia and co-precipitated with $BaCrO_4$, acting as an isomorphous carrier, after which $BaSO_4$ was reduced to BaS by submitting the precipitate to a calcination with carbon; by acting with a $K_3Fe(CN)_6$ solution, the sulfide was transformed into elementary sulfur which was then dissolved in benzol; the radioactive P^{32} (14.3 days) which forms, together with S^{35}, during the irradiation with neutrons, does not dissolve in benzol. (auth)

2066 Some General Properties of Nuclear Reaction and Scattering Cross Sections. T. Teichmann. Phys. Rev. 77, 506-15(1950) Feb. 15.

This paper deals with some general properties of nuclear reaction and scattering cross sections which can be derived from the dispersion-theoretic treatment of nuclear reactions as given, for example, by Wigner and Eisenbud (Phys. Rev. 72, 29(1947)). The form of the cross section near the resonances is found to satisfy the Breit-Wigner formula with corrections of the order Γ^2/D^2, Γ = level width, D = level spacing (Phys. Rev. 70, 606(1946)). In the region between the resonances, the behavior is found to be of three types. In the first two types, simple minima occur differing in order of magnitude in the two cases by a factor Γ^2/D^2. In the third type, a flat nonresonance maximum occurs between the resonances considered, accompanied by two minima. This type of behavior may be associated with a large fluctuation of Γ or D at some of the neighboring levels. The cross sections are explicitly calculated for some special choices of the Γ and D and the averages compared with those of the statistical theory. The effect of the potential scattering on the scattering cross sections is briefly discussed. (auth)

2067 Apparatus for Imparting High Energy to Charged Particles. Willem F. Westendorp (to General Electric Co., Schenectady, N. Y.) U. S. Patent 2,480,169, Aug. 30, 1949.

Various structural improvements of the betatron are described which provide the following advantages: (a) the magnetic system is made more compact and its mass is reduced; (b) access to the discharge chamber in which the particles are accelerated is made easier; (c) the ejection of accelerated particles or radiation from the chamber is facilitated.

2068 Double Orbit in the 30-Mev Synchrotron. J. D. Lawson. Nature 165, 109-10(1950) Jan. 21 (Letter to the editor).

An examination of the shape of the γ-ray output pulse of the Malvern 30-Mev synchrotron (Fry et al, Nature 161, 504(1948)) shows two distinct pulses, both when the machine is working as a synchrotron and as a betatron. When the machine is working as a synchrotron, both pulses occur after the radio-frequency is switched off, one at the expected time, the other much sooner. The existence of the earlier pulse may be explained in terms of a resonance phenomenon be-

tween the second harmonic of the betatron oscillation frequency (Courant, J. Applied Phys. 20, 611(1949)). The possibility of such an explanation is discussed qualitatively. The hypothesis was tested by putting pieces of laminated iron around the betatron magnet just outside the pole pieces. These disturbed the field, altering the relative sizes of the two pulses. By a proper arrangement of the laminated iron all the particles could be concentrated into either of the pulses.

2069 Imparting High Energy to Charged Particles. Herbert C. Pallock and Willem F. Westendorp (to General Electric Co., Schenectady, N. Y.). U. S. Patent 2,485,409, Oct. 18, 1949.

A high energy accelerator is described which is claimed to be capable of providing electron energies up to 100 Mev. Initially accelerated by a time-varying magnetic flux, the electrons are then subjected to a localized electric field of cyclically varying character. This method is characterized by requiring a minimal amount of magnetic material, and an accelerating chamber of dimensions readily obtainable in practice.

2070 Proposed New Proton Synchrotron. Gordon F. Hull, Jr. Office of Naval Research, London Branch. Technical Report No. OANAR-48-49, Dec. 28, 1949. 5p.

Professor M. L. E. Oliphant of the University of Birmingham is planning to build a novel proton synchrotron delivering between 1 and 2 Bev protons. This proton synchrotron has the following unique features: (a) it will be compact with magnet pole pieces about 11 ft in diameter; (b) it can be built up in stages; the first as a cyclotron, second as a synchro-cyclotron, and third as a synchrotron. (auth)

2071 Survey of Possible Experiments with Linear Electron Accelerators. L. I. Schiff. Stanford University Technical Report No. 102, Nov. 1949. 26p. (NP-1367.)

In this report an attempt is made to survey experiments that could be performed with linear electron accelerators of various energy outputs. The first section lists a large number of experiments that could be performed with fast electrons, fast positrons, and hard γ rays, together with a brief statement, in most cases, of why the results obtained would be expected to be of physical interest. The remaining sections select a few of these for more careful consideration, giving wherever possible estimates of the probable magnitudes of the effects to be observed and of possible competing effects. references.

2072 Waveguide Bridge Circuits for the Combination of Unequal Powers with Special Reference to Linear Accelerator Feed-Back Systems. L. B. Mullett and B. G. Loach. Atomic Energy Research Establishment Report No. AERE-EL/R-391, Oct. 1949. 39p.

This report describes waveguide bridge systems for combining two r-f powers in any given ratio. The first is a development of the conventional "Rat-race" structure while the second is based on a "Magic T" system with two of the four arms replaced by a circular H_{11} guide carrying two polarizations at right angles. The application of these devices to accelerator feed-back systems is described. The theory

of the variation in power division between the accelerator input and the load, with the attenuation in the accelerator and the phase of the power in the feed-back arm, is discussed. A method for obtaining automatic phase control is considered. Some practical considerations and experimental results are included. (auth)

2073 Coherent Scattering of X-rays by Atoms with More Than One Electron According to the One-electron Theory and the Positron Theory. E. Arnous. Phys. Rev. 77, 149(1950) Jan. 1 (Letter to the editor).

The "one-electron theory" and the positron theory cannot give identical expressions for the coherent scattering of x-rays by atoms since vacuum polarization terms, for example, cannot enter into the "one-electron theory" calculations. The differences in the results of the two theories may be separated into two classes: those which are encountered for the atom with many electrons as well as for the hydrogen atom, and those which are due to the interaction between electrons. The author demonstrates that the discrepancies which should appear in the two types of calculations cannot be attributed to this interaction.

2074 Corrections for Beta-particle Self-absorption. A. H. Aten, Jr. Nucleonics 6, 68-74(1950) Jan.

In tracer work it is often necessary to determine the specific activity of samples containing various concentrations of a β-active tracer. This is done by comparing the activities of the samples with the activity of standard preparations. The results of such measurements are affected by self-absorption of the radiation in the sample itself, unless the thickness is negligible. If the thickness of the samples is very large all the radiation may be assumed to come from a surface layer and, if certain precautions are observed, self-absorption may again be neglected. However, in intermediate cases, measurements must be corrected for this effect. This may be accomplished with the aid of a theoretical expression derived by the author, involving the absorption coefficient of the sample. If the activity of the sample is measured with and without an aluminum absorber, the corrected activity may be read off a set of graphs presented in the article. Activity measurements and self-absorption corrections are tabulated for several samples containing Ca^{45}.

2075 Determination of the Energy Distribution of Bremsstrahlung from 19.5-Mev Electrons. H. W. Koch and R. E. Carter. Phys. Rev. 77, 165-74(1950) Jan. 15. (See also NSA 3-712.)

The conventional target of a 22-Mev betatron has been replaced by a 0.005-in. platinum target and the intensity spectrum of x-rays produced in the platinum by betatron-accelerated electrons has been measured. The kinetic energy of the monenergetic electrons at the time of expansion was 19.5 Mev. The x-rays were collimated and observed in the forward direction by studying the electron-positron pairs produced in a cloud chamber filled with air. About 1,300 pairs were measured. The intensity spectrum of x-rays is calculated from the pair energy distribution and is compared with the bremsstrahlung theory of Bethe and Heitler. The experimental intensity in the region of 10 Mev is found to be higher than the theoretical value by an amount which is larger than the statistical uncertainty of the experiment. Some details of the pair production process are given, and methods of

correcting for instrumental discrimination are discussed and applied. The subject matter in this article was first set forth in a letter to the editor Phys. Rev. 75, 1950(1949) June 15 (see also NSA 3-712). (auth)

2076 An Evaluation of Quantitative Procedures for the Estimation of Intensities of Diffracted Electrons, Task Order I, Technical Report, June 15, 1947 - January 1, 1949. S. H. Bauer, F. A. Keidel, and R. B. Harvey. Cornell University, Feb. 1, 1949. 290p. (NP-1094.)

This report consists of five sections as follows: the problem of intensity measurements; the determination of scattered intensity; limitations in resolution of gas diffraction patterns; a study of nozzle design; optimum design features. Seven appendixes. References.

2077 Measurements of Gamma-ray Absorption Coefficients. Charlotte Meaker Davisson and Robley D. Evans. M. I. T. Laboratory Nuclear Science and Engineering Technical Report No. 37, Feb. 1, 1950. 63p. (NP-1386.)

The absorption of γ rays in Al, Cu, Sn, Ta, and Pb was measured by use of γ rays from I^{131}, Cu^{64}, Mn^{54}, Co^{60}, Zn^{65}, and Na^{24}. Tests showed that scattering from nearby objects and from the absorber were negligible. Tests of the absorption of radium γ rays in Pb showed good agreement with other workers and with theory. The absorption curves of I^{131} showed the presence of a 0.65 Mev γ ray about 15% as abundant as the 0.367 Mev γ ray. Absorption coefficients measured with the other sources showed agreement within 0.5% to 2% with theory. An anomalous absorption coefficient (5% less than expected) with tantalum absorber (Z = 73) and Zn^{65} and Co^{60} sources ($h\upsilon \sim 1.2$ Mev) needs re-investigation. 76 references.

2078 Proton-Proton Scattering and the Triplet Range of Nuclear Force. P. Swan. Phys. Rev. 77, 288(1950) Jan. 15 (Letter to the editor).

Information on the proton-proton triplet interaction was obtained by analysis of Wilson's experiments (Phys. Rev. 71, 384(1947)) on p-p scattering at 10 Mev, at which energy p wave scattering first becomes important. The p wave scattering phase K required to fit the experimental angular distribution was calculated to be (-0.4 ± 0.1) deg, in good agreement with the value given by Foldy (Phys. Rev. 72, 731(1947)). Using this value and the known value of the deuteron binding energy, the relation between the depth and width of the n-p triplet well is calculated and plotted. A similar relation may be obtained for the p-p triplet well. The intersection of these two curves gives a value for the common range of the n-p and p-p interactions, a value which is in good agreement with that obtained by other methods. The triplet potentials for the two interactions are found to differ slightly.

2079 X-ray and Gamma-ray Reflection Properties from 500 X Units to 9 X Units of Unstressed and of Bent Quartz Plates for Use in the Two-Meter Curved-Crystal Focusing Gamma-ray Spectrometer. D. A. Lind, W. J. West, and J. W. M. DuMond. Phys. Rev. 77, 475-90(1950) Feb. 15.

The x-ray and γ-ray reflection properties of the (310) planes of quartz have been investigated over the wavelength range 500 to 9 X units for the Laue or transmission case. The plates were inhomogeneously stressed by bending to a cylinder with a radius of 200 cm. The value of the integrated reflection coefficient was deduced from the luminosity properties of the curved-crystal spectrometer for seven different wavelengths. The data indicate that the integrated reflection coefficient R_θ for a bent crystal varies as λ^3 over the range of wave-lengths studied. This behavior is in accord with that of a mosaic crystal. The reflection properties of the (310) planes of an unstressed crystal plate cut from the same sample were measured over the range 700 to 120 x.u. by the two-crystal spectrometer technique. These results indicate that the unstressed quartz plates behave more nearly as perfect crystals. Data are given on the integrated reflection coefficient, the peak value of Laue reflection coefficient, and the width at half-maximum of the diffraction curve for the unstressed case. (auth)

2080 Absolute Measurements of the Activity of Beta Emitters. J. L. Putman. J. Brit. Radiology 23, 46-63(1950) Jan.

This is a review of methods used to determine the absolute β-decay rate of radioisotopes. The β-γ-coincidence method is found suitable for the assay of isotopes which disintegrate by the simultaneous emission of a β particle and one or more γ rays, provided the source is approximately a point source, the efficiency of the β counter approximately is the same for all β particles and that of the γ counter for all γ rays, and there is little internal conversion of the γ rays. The statistics of such coincidence counting are discussed. Defined solid angle methods are found especially suitable for pure β emitters. Two kinds of apparatus for this purpose are described, one of them including a windowless counter of demountable type. A 4π solid angle counter with an internal source is suggested, particularly for the assay of positron emitters. Liquid counters used as sub-standards are described and methods of ensuring reproducible standards given. A resumé is made of the present state of agreement between various observers upon absolute standards of activity, particularly for the isotopes Co^{60}, Na^{24}, P^{32}, and I^{131}.

2081 β Decay of RaE. A. S. Zavel'skiĭ, G. Ya. Umarov and S. Kh. Matushevskiĭ. Zhur. Eksptl. i Teoret. Fiz. 19, 1136-40(1949)(In Russian).

An investigation of the decay of RaE showed the composite character of its β spectrum. The upper limits of the partial β spectra were determined, and the conversion of γ rays accompanying the decay of RaE studied. Measurements were made of the absorption both of the γ rays and of the electrons emitted by RaE and RaD. The β spectrum of RaE reveals the presence of a considerable number of slow electrons, in disagreement with Fermi's theory; this fact is confirmed by the data on the absorption of the decay electrons. (auth)

2082 The Beta-Ray Distribution of Tc^{99}. B. H. Ketelle and John W. Ruch. Phys. Rev. 77, 565-6(1950) Feb. 15 (Letter to the editor).

The β-ray spectrum of Tc^{99} was determined with a thin lens spectrometer constructed and described by Peacock (Phys. Rev. 72, 1049(1947)). A Kurie plot of the data is given. The maximum β energy is 0.30 ± 0.01 Mev. Since no conversion lines were observed with the spectrometer and no γ radiation was detectable when the source was counted

PHYSICS

with a thin window Geiger counter, Tc^{99} seems to decay by simple β emission. The observed half-life is 5×10^5 to 9×10^5 years, while the theoretical half-life, computed by the authors according to the method of Greuling (Phys. Rev. 61, 568(1942)) is 10^5 years.

2083 The β-Ray Spectra of Light Elements. Albert Alan Townsend. p.127. Abstracts of Dissertations Approved for the Ph. D., M. Sc., and M. Litt. Degrees in the University of Cambridge, 1947-1948. Cambridge, University Press, 1949.

The β-ray spectra of C^{11}, N^{13}, Mn^{56}, Cu^{64} (positrons and negatrons), and Zn^{63} were measured in a β-ray spectrometer, and the energy distributions were compared with those predicted by the Fermi theory of β-ray decay. The agreement is generally good at the high energy end of the spectrum, but there are more low energy electrons than the theory predicts. It is suggested that deviations from the Fermi distribution increase with increasing atomic number and decreasing energy of disintegration. (auth)

2084 The Beta-Rays of K^{40}. P. R. Bell, Boyd Weaver, and J. M. Cassidy. Phys. Rev. 77, 399-400(1950) Feb. 1 (Letter to the editor).

The β spectrum of K^{40} has been measured from an enriched sample by use of the scintillation spectrometer. Enriched material was prepared by electromagnetic separation at Y-12. The sample used consisted of 12.2 mg of KCl mounted on 0.5 mg/cm polyethylene. The surface density of the sample was estimated to be 2.5 mg/cm^2. The K^{40} content of the potassium in this sample was 1.31 ± 0.05% as measured at Y-12 by mass spectrometer. The pulse distribution data were corrected for the resolution of the instrument and a Fermi-Kurie plot was made. This plot is markedly concave to the energy axis above 700 kev and the end point is 1.36 Mev. The correction term for the third forbidden axial vector or tensor interaction produces a curve which is very close to a straight line.

2085 Beta-Spectrum and Decay Scheme of $_{65}Tb^{160}$. S. B. Burson, K. W. Blair, and D. Saxon. Phys. Rev. 77, 403-4(1950) Feb. 1 (Letter to the editor).

The β spectrum of Tb^{160} has been investigated in the Argonne 180-deg spectrometer. The purified sample of Tb_4O_7 from Oak Ridge was bombarded in the Argonne heavy water pile for about 90 days and allowed to cool for about one month. The activity of a portion of the sample was then followed for ~3 months indicating a half-life of 71 ± 1 day. A momentum plot of the spectrum is given. Lines appearing in this plot may be assigned to conversion electrons from several γ rays of Dy. The energies and line assignments of these conversion electrons are tabulated, as well as the corresponding γ-ray energies. The γ-ray energies of 85, 200, and 300 kev agree well with those reported previously (Cork et al, Phys. Rev. 74, 240(1948)), but the previously reported γ ray of 212 kev was not observed. Two groups of Auger electrons were also observed. The Kurie plot of the β spectrum appears to consist of three linear portions down to an energy of 230 kev, below which there is an upward trend. The linear portions gave end points of 850, 520, and 396 kev. No positron decay was observed. A decay scheme is proposed, and the relative intensity of the three components of the β spectrum are given.

PHYSICS

2086 The Beta-Spectrum of He^6. V. Perez-Mendez and H. Brown. Phys. Rev. 77, 404-5(1950) Feb. 1 (Letter to the editor).

The β-ray spectrum of He^6 has been investigated in a β spectrometer for gaseous emitters (Brown and Perez-Mendez, Phys. Rev. 75, 1276(1949)). The He^6 is produced by a (n, α) reaction by bombarding finely divided beryllium powder with fast neutrons from the Columbia cyclotron. Special arrangements, described in the article, were made to obtain high specific activity. The neutrons were produced by bombarding beryllium with a deuterium beam, and the counting circuits had to be turned on automatically ¼ sec after the cyclotron was turned off. This was necessary because of the short half-life of He^6. A Fermi plot of one of the spectra obtained, without corrections for window absorption or resolution, is given. The end point, obtained from an average of such plots following subtraction of the energy loss in the source window near the end point, is 7.30 mc^2. Furthermore, the spectrum seems to be allowed down to 200 kev. The ft value (570) is the smallest known. Both the low ft value and the allowed shape appear to confirm the Gamow-Teller selection rules, assuming that the isotope has a spin of zero.

2087 Calculation of Decay Times from Coincidence Experiments. Z. Bay. Phys. Rev. 77, 419(1950) Feb. 1 (Letter to the editor).

Using delayed coincidence circuits for the measurement of short radioactive half-lives, one has to measure the genuine coincidence rate N_g as a function of an artificial delay time T deliberately put in either channel. The mean life θ has to be calculated from the delay curve N_g (T) of the experiment. Such calculations are generally based on some assumptions or knowledge concerning the time delays in the equipment and concerning the resolving time τ. The results of the calculations is a theoretical delay curve, which can be compared with the measured delay curve. The author has developed a method of calculating the half-life without the use of theoretical delay curves. This method involves a supplementary delay curve $\nu(\tau)$ obtained under the condition that the events producing the coincidences have no time delay between them. The half-life can then be determined from the moments of the curves $N_g(T)$ and $\nu_g(T)$.

2088 Composite of Experimental Measurements of the Energy-Distribution Among Beta-Particles from Tritium. E. P. Cooper and F. T. Rogers, Jr. Phys. Rev. 77, 402-3(1950) Feb. 1 (Letter to the editor).

The β spectrum of H^3 lies at such low energies that relativistic effects may be neglected. Since the screening effects are also small in this case, the β decay of H^3 should provide a simple and critical test of the Fermi theory at low β energies. The authors have constructed a composite of the various published spectra and compared this plot with a theoretical Fermi plot using the nonrelativistic coulomb factor. In general the agreement between the curves is good, although small deviations are found below 2.5 and above 18 kev.

2089 Gamma-Rays of K^{40}. P. R. Bell and J. M. Cassidy. Phys. Rev. 77, 409-10(1950) Feb. 1 (Letter to the editor).

The scintillation spectrometer has been used to investigate the K^{40} γ radiation and to search for annihilation radiation associated with possible positron emission. The γ rays pro-

PHYSICS

duce Compton electrons in an anthracene crystal and the spectrum of these Compton electrons is measured by determining the pulse distribution from an RCA C-7132 photomultiplier to which the anthracene crystal is cemented. The γ ray was compared with the low energy γ from Na^{24}, the γ ray of Zn^{65}, and the conversion line of Cs^{137}; γ-ray spectra are given for these different sources. The authors conclude that the number of positrons emitted by K^{40} must be less than half the number from Zn^{65}, and that therefore the number of positrons emitted must be less than 1% of the K capture transitions to the excited state of A^{40}. This lack of positron emission makes it improbable that there is any large number of K captures to the ground state of A^{40}.

2090 The Half-Life of Br^{82}. E. Berne. Phys. Rev. 77, 568-9(1950) Feb. 15 (Letter to the editor).

The half-life of Br^{82} was measured in a series of six experiments by means of Geiger counters. During each experiment a Pb^{210}(RaD) standard was measured three times an hour and the measured Br^{82} activity was corrected for small changes in the counter. The results are:

Series	Half-life (hr)
1	36.1 ± 0.1
2	36.5 ± 0.2
3	35.0 ± 0.3
4	35.9 ± 0.2
5	36.7 ± 0.4
6	35.7 ± 0.2

2091 An Investigation of the Disintegration Schemes of Ru^{103} and Rb^{86}. C. E. Mandeville and E. Shapiro. Phys. Rev. 77, 439-41(1950) Feb. 15.

The disintegration schemes of the 42-day Ru^{103} and the 19-day Rb^{86} have been studied with the use of absorption and coincidence methods. Ninety-two per cent of the disintegrations of Ru^{103} proceed by way of an inner β-ray group at 0.15-Mev coincident in time with a γ ray of energy 0.52 Mev, which is (4 ± 1)% converted. A harder β spectrum having a maximum energy of 0.68 Mev leads to the ground state of Rh^{103}. It is estimated that (12 ± 2)% of the β rays of Rb^{86} are contained in the inner spectrum. Absorption measurements confirm the energy values given by the Indiana group (Zaffarano et al, Phys. Rev. 74, 682(1948); 74, 1049(1948)). (auth)

2092 The Isomer of Technicium 99. H. Medicus, D. Maeder, and H. Schneider. Helv. Phys. Acta 22, 603-5(1949) July 1 (in German).

Mo^{99} was obtained by bombarding molybdenum trioxide with slow neutrons in the Harwell pile. This isotope then decays into the Tc isomer. Beta and γ-absorption measurements, made with a source consisting of Tc produced in this process, in conjunction with a study of conversion and photoelectrons, indicated the presence of a γ ray of 141.2 kev. This γ is 10% converted and the ratio of K to L conversion coefficients is 8.1. From this fact the author concludes that dipole radiation is emitted in this transition, and that the isomeric state must result from a previous transition. Coincidence measurements and measurements in a proportional counter detected a soft radiation of 1.8 kev in cascade with the 141 kev radiation. This soft radiation appeared to be

PHYSICS

produced in a transition with a change of angular momentum $\Delta 1 = 3$. The authors have also studied the decay spectrum of Mo^{99}.

2093 Measurement of Some Weak γ-Ray Intensities. G. R. Bishop, Richard Wilson, and H. Halban. Phys. Rev. 77, 416-17(1950) Feb. 1 (Letter to the editor).

The authors have measured the intensities of some weak high energy γ-rays by counting the photo-protons produced by the disintegration of deuterium in an ionization chamber counter (Wilson et al, Nature 163, 245(1949)). The half-lives of some of the sources have been redetermined by a method previously described (Wilson and Bishop, Proc. Phys. Soc. (London) 62, 457(1949)). In some cases the high energy γ-rays coincided with expected crossover transitions; in other cases the crossover transition was not found. The results are tabulated and compared, where possible, with the theoretical intensities calculated from proposed decay schemes. The following sources were used: ThC'', RaC', RaC'', Ga^{72}, La^{140}, Mn^{56}, and Na^{24}.

2094 On the Angular Distribution of Two-Photon Annihilation Radiation. S. DeBenedetti, C. E. Cowan, W. R. Konneker, and H. Primakoff. Phys. Rev. 77, 205-12 (1950) Jan. 15.

An experimental determination, using anthracene scintillation counters in coincidence, has been made of the departure from antiparallelism of the two photons in the pair annihilation process in an Au absorber. The observed mean angular departure, ≈1/137 radians, arises from the motion of the centers of mass of the annihilating pairs; the mean momentum of these is found from the experimental data to be equal to 1.2 mc/137, a value to be compared with a lower limit of 0.8 mc/137 obtained from an included theoretical discussion in which the momentum probability amplitudes of the annihilating electrons and positrons (in the absorbing metal) are estimated and appropriately combined. In these estimates it is shown that the positrons become thermalized by collisions with the vibrating lattice atoms in times considerably shorter than the annihilation time, so that only their zero point motions, together with the zero point motions of the annihilating (valence) electrons, effectively contribute to the momenta of the centers of mass of the annihilating pairs. (auth)

2095 On the Calibration of Sources of the Gamma Rays of ThC''. R. Bouchez. J. phys. radium 10, 415-16 (1949) Dec. (in French).

Using the data obtained by Ricoux (J. phys. radium 8, 388 (1937)) and Winand (ibid. 10, 361(1939)) and the newly accepted value for the curie, the author has calculated that a "milligram Ra - equivalent" of RaTh (Th^{228}), a quantity determined by ionization chamber measurements, corresponds to 4.00×10^7 disintegrations/sec of ThC(Bi^{212}) and emits 1.36×10^7 photons of 2.61 Mev/sec, originating from ThC'' (Tl^{208}); using 3.60×10^{10} dis/sec as the value of the curie, this "milligram Ra - equivalent" of RaTh corresponds to 1.11 mc.

2096 On the Deformation, with Depth, of the Decay Curves of Metals Irradiated with Deuterons. C. Chamié and H. Filcakova. J. Phys. radium 10, 387-90(1949) Dec. (in French).

PHYSICS

Metals (Au, Ag, Cu, Ni in thin, superimposed, plates) exposed to deuterons displayed the following characteristics; the decay curves of the induced activity became more and more deformed at increasing distances from the exposed surface of the pile of plates. Short period activities of unknown origin were observed in the deep layers of the pile. Some of the observed activities remained constant with increasing depth, or even showed maxima at certain depths. Also, the activity does not fall to zero beyond the range of the deuterons, and may be observed at great depths, where it increases in certain layers, instead of decreasing. In order to explain these anomalous activities it is necessary to consider the secondary reactions produced by the neutrons and protons emitted in the deuteron reactions. (auth)

2097 On the Spectrum of the Positronium. V. B. Berestetskiĭ. Zhur. Eksptl. i Teoret. Fiz. 19, 1130-5 (1949)(in Russian).

Most of the works on the positronium, i.e., on the system comprising an electron and a positron, were concerned with its lifetime before the annihilation, (the last cited here is Ivanenko and Sokolov, Doklady Akad. Nauk S. S. S. R. 61, 51 (1948)). In the present paper the peculiarities of the energy spectrum of the positronium are investigated. The Hamiltonian of the system has been determined by the author in Zhur. Eksptl. i Teoret. Fiz. 19, 673(1949); the operator of the perturbation is calculated here. The calculation of the fine structure of the energy levels shows that the exchange interaction gives rise to an additional, (beyond the usual "superfine" structure), splitting of the S-states. The Zeeman phenomenon shows no linear effect.

2098 Study of the Gamma Radiation of Ionium. Irène Curie. J. phys. radium 10, 381-6(1949) Dec. (in French).

A Geiger counter study has been made of the γ radiation of ionium. Eleven quanta of the L radiation of radium were observed for every hundred α disintegrations, and three γ rays were found with energies of 68, 140, and 240 kev at a rate of 0.85, 0.33, 0.05 quanta, respectively, for 100 disintegrations. It is noted that the radiation spectrum of ionium as a whole is difficult to interpret. In the course of this work, the author calculated the efficiency of a thin-walled aluminum counter, both for the L radiation of radium and for γ rays of 68 kev. The author also measured, for soft radiation, the ratio between the efficiency of a thin-walled aluminum counter and that of a similar counter lined with 0.11 mm of lead. (auth)

2099 Tables of Data on the β Decay. I. Products τf. B. S. Dzhelepov and A. V. Kudryavtseva. Zhur. Eksptl. i Teoret. Fiz. 19, 761-83(1949)(in Russian).

On the basis of the latest data on 313 β emitters, tables of τf are given; τ is the half-life period, and f is a certain function $f(Z,E')$ whose form, in the case of allowed transitions, is given by Fermi's theory (Z. Physik 83, 161(1934)), E' being the maximum energy in the β spectrum. The products τf are approximately equal for β decays belonging to the same category of forbiddenness, and they must strongly differ in different categories. The material accumulated since the publication of Konopinsky's table (Revs. Modern Phys. 15, 209(1943)) motivated the present work.

PHYSICS

2100 Energy Levels of a Vector Meson in a Smeared Coulomb Field. Albert Simon. Phys. Rev. 76, 1877(1949) Dec. 15 (Letter to the editor).

Corben and Schwinger (Phys. Rev. 58, 953(1940)) have derived the radial equations for a vector meson in a central field, and have shown that the states of the vector meson may be divided into two groups. One corresponds to the states of the scalar meson, and the second group contains linear combinations of the states for which $l = j - 1$ and $l = j + 1$. Solutions for the latter group of states exist, in a coulomb field, only for the special case $j = 0$. This, however, is no longer true when the effect of the finite size of the nucleus is considered. The energy levels of the scalar states have been corrected for this effect, and it was found that no cut-off device is necessary in this calculation. If the same treatment is applied to the radial equations for a meson of arbitrary magnetic moment, a cut-off would be necessary for the states $l = 0$.

2101 Higher Approximations in the External Field for the Problem of Vacuum Polarization. G. Källén. Helv. Phys. Acta 22, 637-54(1949) Dec. 1.

The convergence and gauge invariance of the integrals appearing in the higher approximations of vacuum polarization are discussed for the cases of spinor and scalar fields. Only the comparatively simple case of an external electromagnetic field is treated. It is shown that only the e^2 and e^4 approximations diverge, but that the still higher terms are both convergent and gauge invariant. It further appears that, apart from a numerical factor, which is the same in both approximations (and equal to $-\frac{1}{2}$), the strongest divergences are the same for the spinor and the scalar fields. The e^2 approximation has previously been treated by Jost and Rayski (Helv. Phys. Acta 22, 457(1949)), who have shown that the nongauge invariant (and divergent) terms compensate each other if one uses a suitable mixture of spinor and scalar fields. In this approximation, however, the logarithmically divergent charge renormalization remains. The conditions of Jost and Rayski are

$$N = 2n \qquad (I)$$

$$\sum_{i=1}^{N} M_i^2 = 2 \sum_{i=1}^{n} m_i^2 \qquad (II)$$

where N and n are the number of scalar and spinor fields respectively and M_i and m_i are the corresponding masses. In the e^4 approximation the condition (I) alone is sufficient to secure a convergent and gauge invariant result. (auth)

2102 International Congress on Statistical Mechanics; Florence, Italy, May 17-20, 1949. Paul M. Marcus. Office of Naval Research, London Branch. Technical Report No. OANAR-23-49, Sept. 6, 1949. 23p. (NP-1114.)

A brief account is given of the following papers presented at the conference: The Caloric and Thermal Equation of States in Quantum Statistical Mechanics, by J. de Boer; On the Equilibrium of Liquids, by J. Yvon; Distribution Functions and Integral Equation Methods, by Joseph E. Mayer; On the Statistical Derivation of the Laws of Chemical Equilibrium, by O. Klein; Quantum Foundations of Statistical Mechanics, by Max Born; The Statistical Mechanical Theory

PHYSICS

of Irreversible Processes, by J. G. Kirkwood; On the Perturbation of the Maxwell Distribution by Chemical Reactions, by I. Prigogine; Some Aspects of Onsager's Theory of Reciprocal Relations in Irreversible Processes, by H. B. Casimir; Statistical Hydrodynamics, by L. Onsager; Cooperative Free Energy, by E. A. Guggenheim; Continuum Models of Cooperative Phenomena, by E. Montroll; Phase Changes in Regular Solutions, by C. S. Rushbrooke; Discussion of the Properties of Liquid Helium II, by C. J. Gorter, et al; Statistics of Nuclei at High Temperatures; by G. Wataghin.

2103 Longitudinal Photons in Quantum Electrodynamics. F. J. Dyson. Phys. Rev. 77, 420(1950) Feb. 1 (Letter to the editor).

Schwinger has pointed out that it is, in practice, unnecessary to separate the effects of longitudinal and transverse photons (Phys. Rev. 75, 668(1949)), but was obliged to start from a treatment involving such a separation in order to show that the separation is unnecessary. Other workers have used the same approach (Hu, Phys. Rev. 76, 391(1949)), which the author does not consider satisfactory. A simple proof of the correctness of the unseparated treatment of the field, within the framework of the Schwinger theory, is outlined.

2104 Note on a Relation in Dirac's Theory of the Electron. G. E. Brown. Proc. Natl. Acad. Sci. U.S. 36, 15-16 (1950) Jan.

By transforming an integral which appears in the relativistic hyperfine structure energy formula (Breit, Phys. Rev. 38, 463(1931)), the author proves that the hyperfine structure energy of an electron in a coulomb field is proportional to (r^{-2}), where the parentheses refer to the expectation value of the enclosed operator. This is analagous to the result obtained in the nonrelativistic theory of hyperfine structure.

2105 On the General Formulation of Meson Pair Theory. Stig Hjalmars. Arkiv Fysik 1, 41-116(1949).

The purpose of this paper is to formulate the most general pair interaction between nucleons and charged scalar and vector mesons. As was pointed out in an earlier note (Arkiv Mat. Astron. Fysik 34A, 15(1947)), a natural and convenient method of developing the meson pair theory is to make use of the generalized Dirac equation for the meson. The theory of generalized Dirac equations is reviewed and the conditions are derived for the Lorentz invariance and Hermiticity of the pair interaction term and for the conservation of the mesonic and nucleonic charge. This general theory is applied to nucleons and to scalar and vector mesons. The pair theory is formulated and the most general pair interactions listed. It is shown to be possible to perform a charge symmetric quantization of the meson field. In the representation used the charge conjugate wave function is identical with the transposed adjoint wave function. After the elimination of redundant components the Hamiltonian is expressed as a function on nonredundant components and their spatial derivatives only. Finally, a brief discussion is given of the alternative method of developing the pair theory by means of a Lagrangian formalism.

2106 On the Motion of Particles in a Traveling Wave Linear Accelerator. John R. Terrall. Phys. Rev. 77, 415-16(1950) Feb. 1 (Letter to the editor).

PHYSICS

A dynamical solution is given of the Lorentz equations of motion for a particle in a traveling wave linear accelerator, i.e., the energy is given as a function of the distance traveled in the field. From this solution the author concludes that the energy spectrum of a beam of particles traversing the accelerator depends greatly on the initial phase spread of the beam so that pre-bunching is necessary to obtain appreciable final energy homogeneity of the beam.

2107 Problems on Electrons and Electromagnetic Radiation: A Generalization of the Method of Separating Longitudinal and Transverse Waves in Electrodynamics. Sonja Ashauer. p. 80-81, Abstracts of Dissertations Approved for the Ph. D., M. Sc., and M. Litt. Degrees in the University of Cambridge, 1947-48. Cambridge, University Press, 1949.

A generalization of the method of separating longitudinal and transverse waves in electrodynamics is proposed. Each Fourier-component of the wave-field four-vector is split up with respect to two null-vectors k and l_k, where k is the Fourier vector of propagation, and l_k is an arbitrary function of k satisfying $(l_k,k) = 1$ and $l_{-k} = -l_k$. This amounts to referring each Fourier-component of the field to a different time-axis in the usual method of splitting up. l_k may also depend on the coordinates of the particles of the system. The longitudinal field variables are eliminated from the Hamiltonian formulation of electrodynamics by a contact transformation, and replaced by a term depending on the coordinates of the particles and, in general, also on the transverse field variables. The work holds both in the classical and quantum theories. For the problem of a fast electron moving in the field of a nucleus, a particular form is chosen for the l_k, which depends on the initial velocities of both the particles. The classical deflection formula is derived by neglecting the interaction with the new transverse field. Although, for a slow electron, the new method does not lead to the usual deflection derived from the coulomb interaction with neglect of the usual transverse waves (which means neglecting radiation damping in a certain way) and with neglect of the nuclear recoil, it may be more suitable for a high-energy electron. (auth)

2108 Problems on Electrons and Electromagnetic Radiation: On the Non-physical Solutions of the Classical Equations of Motion of the Radiating Electron. Sonja Ashauer. p. 80. Abstracts of Dissertations Approved for the Ph. D., M. Sc., and M. Litt. Degrees in the University of Cambridge, 1947-48. Cambridge, University Press, 1949. (See also NSA 3-1492.)

The equations of motion of Dirac's self-accelerating electron are solved, and the surfaces of constant scalar potential and the field energy distribution are studied graphically when the electron has already built up a velocity close to the velocity of light. In this case, the bulk of the field-energy is found to be concentrated in a small disk-like region close to the electron. The exact solution of the Lorentz-Dirac equations of motion of an electron disturbed by a pulse of radiation are worked out and discussed. (auth)

2109 The Quantum Theory of the "Luminous" Electron. A. Sokolov. Doklady Akad. Nauk S. S. S. R. 67, 1013-16(1949)(in Russian).

PHYSICS

An electron moving in a circle of radius "a" (as in accelerators) is a source of electromagnetic radiations. The phenomenon has been studied theoretically by Russian physicists for several years, starting with the prediction, made by Ivanenko and Pomeranchuk (Doklady Akad. Nauk. S. S. S. R. 44, 343(1944)), of a visible radiation, which was later observed by Elder et al (Phys. Rev. 71, 829(1947)). In Doklady Akad. Nauk. S. S. S. R. 59, 1551(1948), Ivanenko and Sokolov gave formulas covering the whole spectrum of the radiation, and showed that the intensity maximum lies in the region of harmonic numbers $n = (E/mc^2)^3$, where E is the energy of the rotating electron. In the present note, the quantum-mechanical corrections are considered, which are to be introduced in the radiation curve, and a determination is made of the limits of applicability of the classical theory to the phenomenon of the "luminous" electron. Denoting by Λ the length of de Broglie's wave of the electron, it can be written that in the classical approximation ($\Lambda = 0$), transitions between circular orbits are the only possible, and that the ratio between the quantum-mechanical and the classical corrections is of the order of magnitude $n^2\Lambda/a$, while the corresponding ratio for the frequencies of the radiation is of the order $n\Lambda/a$.

2110 Some Applications of Meson Theory. Hilmi Samara. p. 84-85. Abstracts of Dissertations Approved for the Ph. D., M. Sc., and M. Litt. Degrees in the University of Cambridge, 1947-1948. Cambridge, University Press, 1949.

The first part of this dissertation contains a short summary of Heitler and Wilson's integral formula for radiation damping, and two approximate methods of its solution are discussed. These methods are applied to obtain the following five scattering cross-sections: the scattering of light by electrons and the scattering of pseudoscalar and vector mesons by protons either through their nuclear (meson) interaction or through electromagnetic interaction. To make the calculations less cumbersome it was found necessary to investigate the cross-sections in two regions only: the very low and the very high energy region. The second part deals with the equation of motion of the meson and its possible generalizations to give the meson an additional magnetic moment. The effect of this generalization on the magnetic moment and nonrelativistic approximation of the equation of

PHYSICS

motion is investigated. The exact solutions of this generalized equation in a constant magnetic or electric field are obtained for both pseudoscalar and vector mesons. These solutions are applied to obtain the effect of the presence of mesons on the electrodynamics of the vacuum, by means of the procedure due to Weisskopf of the subtraction if infinite terms. The parallel generalizations of the equation of the electron, with the solution of this equation in a constant magnetic or electric field, and the electrodynamics of the vacuum due to that are also investigated. From this the result was obtained that the Lagrangian of the electromagnetic field diverges unless the arbitrary constants in the generalized equations of the particles have special values. For the electron and pseudoscalar meson these values give the ordinary particles with no additional magnetic moment; and for the vector meson they give the Corbon Schwinger meson with twice the magnetic moment of the ordinary meson. (auth)

2111 Statistics of Counting. W. C. Elmore. Nucleonics 6, 26-34(1950) Jan.

The main purpose of this article is to present a discussion of the use of the Laplace transformation for finding the moments of probability distributions, with applications to counting losses in scaling circuits having a finite resolving time, at both the input and a later position in the scaling circuit. This discussion is preceded by a condensed presentation of the general statistical theory of counting random events.

2112 Upper and Lower Bounds of Eigenvalues. Tosio Kato. Phys. Rev. 77, 413(1950) Feb. 1 (Letter to the editor).

The author presents, without proof, a method of estimating the upper and lower bounds of the eigenvalues of Hermitian operators which is a generalization of works by Temple (Proc. London Math. Soc. 29, 257(1928); Proc. Roy. Soc. (London) 119, 276(1928)). Let λ be a nondegenerate eigenvalue of a Hermitian operator H, and let $\alpha < \beta$ be two numbers such that the interval (α,β) contains λ but no other points of the spectrum of H. Let w be an approximate eigenfunction and $\eta = (w, Hw)/\| w \|^2$, and $\epsilon = \| (H-\eta) \| / \| w \|$. Then it can be shown that $\eta - \frac{\epsilon^2}{\beta-\eta} \leq \lambda \leq \eta + \frac{\epsilon^2}{\eta-\alpha}$, provided $\epsilon^2 < (\eta-\alpha)(\beta-\eta)$.